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THE CONDOR

Volume 55 May-June 1953 Number 3

JOURNAL OF THE COOPER ORNITHOLOGICAL SOCIETY

V. OF BIRDS

THE CONDOR

JOURNAL OF THE COOPER ORNITHOLOGICAL SOCIETY

Published bi-monthly at Berkeley, California. Entered as second-class matter at the post office at Berkeley, California, May 15, 1925, under Act of Congress of March 3, 1879. Issued from the office of THE CONDOR, Museum of Vertebrate Zoology, Berkeley 4, California.

SUBSCRIPTION RATES

Subscription price to non-members, five dollars per volume, payable in advance. Single copies, one dollar each.

MEMBERSHIP DUES

Active members, four dollars per year in the United States, of which $3.00 is for a year's subscription to The Condor; four dollars and twenty-five cents per year in all other countries in the International Postal Union.

Sustaining members, five dollars per year.

The life membership fee is one hundred dollars. No additional dues are required. The money is invested and the interest only is used for Society publications. Life members receive THE CONDOR without additional charge.

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Send manuscripts for publication to the Editor, ALDEN H. MILLER, Museum of Vertebrate Zoology, Berkeley 4, California, or to the Associate Editor, FRANK A. PITELKA, same address. Refer to suggestions on preparation of manuscripts for THE CONDOR on the back cover of recent issues of the journal.

Issued May 22, 1953

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THE CONDOR

VOLUME 55 MAY-JUNE, 1953 NUMBER 3

RECENT OBSERVATIONS ON BIRDS OF ANAHO ISLAND, PYRAMID LAKE, NEVADA

By DAVID B. MARSHALL and LEROY W. GILES

Within the last thirty years Hall (1925 and 1926), Bond (1940), and Alcorn (1943) have published observations on the birds of Anaho Island and Pyramid Lake, in west-central Nevada. Data gathered by Hall and others, who made trips to the island prior to Bond's visit, are summarized by Thompson (1932). Anaho Island has long been known for the large numbers of White Pelicans (*Pelecanus erythrorhynchos*) and other water birds which use it for nesting purposes. Thompson lists seven large concentrations of nesting White Pelicans in North America; census figures indicate Anaho Island may be the largest of these. The object of this paper is to record the present status of the nesting populations of this major pelican colony and of other water birds on the island (figs. 1 and 2).

Fig. 1. Anaho Island, Pyramid Lake, Nevada, as seen from the east shore. Long peninsula to left of island will eventually join nearby point of mainland as water level recedes.

DESCRIPTION OF AREA

In view of recent changes resulting from receding water levels, a short description of Anaho Island appears advisable. The island is situated approximately one-half mile off-shore in Pyramid Lake. At the time of this writing, Pyramid Lake has a maximum length of about 25 miles, a width varying from 4½ to 11 miles, and averages approximately 205 feet in depth. Maximum depth is about 325 feet. The lake, fed by the Truckee

River, has no outlet. The lake level is dropping rapidly because of the diversion of the river water for agricultural purposes. In December, 1950, the lake elevation stood at 3,803 feet above sea level.

Anaho Island embraces roughly 250 acres at the present time. Its center is characterized by steep, rocky slopes and cliffs which, in 1950, were approximately 557 feet above the water level. From the base of this rocky prominence, the island slopes gently to the water's edge through a descending series of old stranded beaches, relics of ancient Lake Lahontan of Pleistocene times and Pyramid Lake when at higher levels. The vegetation on the island is typically that of the deserts of western Nevada. Patches of saltgrass (*Distichlis stricta*) and alkali weed (*Echinopsilon hyssopifolium*) along the shore give way to sparse growths of big greasewood (*Sarcobatus vermiculatus*), saltbushes (*Atriplex* spp.), and other desert shrubs at higher elevations.

From the description given by Low *et al.* (1950), Anaho Island appears to have a marked similarity, both physically and botanically, to Gunnison Island in Great Salt Lake, Utah, which also is used by White Pelicans for nesting. Both islands are marked by the tiers of beaches left by the receding waters of ancient lakes.

EFFECT OF HUMAN DISTURBANCE AND PROSPECTS OF CHANGE

In 1913 Anaho Island became a wildlife sanctuary, the Anaho Island National Wildlife Refuge, established principally for the protection of the large pelican colony. Trespass or unauthorized interference with any type of wildlife on the island is unlawful.

We found no signs of human activity on the island, and indications are that such interference is no longer a serious menace. The lack of disturbance at the present time is attributed to the difficulties involved in transporting a boat across the wide, sandy beaches to the lake, to poor fishing in the lake waters, and to the necessity of purchasing a permit from the Bureau of Indian Affairs, which administers the Pyramid Lake Indian Reservation.

During World War II, the U. S. Navy used Pyramid Lake as a bombing range. The extent of disturbance and its effects on the nesting populations is not known.

Recent efforts to develop the lake for recreational purposes, which include the stocking of kokanee (*Oncorhynchus nerka kennerlyi*), a land-locked form of sockeye salmon, will, if successful, revive the disturbance problem.

There is some question whether Anaho Island will be able to support, for long, its nesting populations. In the not too distant future, possibly as early as 1965, the island will become a peninsula. At the narrowest interval between the island and the east shore of the mainland, the water is shallow and, because of declining lake levels, is growing progressively shallower. Soundings made in 1948 by Thomas J. Trelease of the Nevada State Fish and Game Commission and Ira LaRivers of the University of Nevada revealed a maximum depth of 38 feet at that time. Trelease has since made annual readings of the level of Pyramid Lake which show that between August 29, 1948, and October 23, 1950, the lake receded 6 feet 10 inches, or roughly 3½ feet per year. This would place the maximum depth between the island and mainland at 31 feet in October, 1950.

The water level drop in 1950 was more than compensated for by floods on the Truckee River late that year. A series of three successive floods quickly filled storage reservoirs, and surplus waters were dumped into the lake. A measured rise of 18 inches occurred in the lake level between November 26 and December 12, and abnormal inflow continued for some time after that period. Floods such as this one, however, occur only occasionally. Under normal water conditions levels may drop even more rapidly in the future if plans which call for an expansion of upstream storage facilities materialize.

PROCEDURE

The island was visited on May 15, June 26, July 3, and September 21, 1950, and on May 15 and July 6, 1951. Each visit was of about five hours' duration, observations being made during the middle of the day. On all but the September trip, estimates and counts were made of the numbers of the various species present. Banding of young birds took place each year on the July trips. The September trip afforded an opportunity to observe the site after the birds had left and to determine nesting mortality.

ACKNOWLEDGMENTS

The writers wish to acknowledge assistance rendered by Thomas J. Trelease, Chief Fisheries Technician, and Fred Wright, Waterfowl Technician, both of the Nevada State Fish and Game Commission. Trelease accompanied us on the June, 1950, trip and identified fish regurgitated by young pelicans and cormorants and also provided us with information on Pyramid Lake water levels. Wright aided in banding operations on the July, 1950, visit. Thomas H. McAllister, of the Oregon State Game Commission, accompanied us on this visit as an observer. On the trip of July, 1951, we were accompanied by Dr. Frank Richardson of the University of Nevada, Ted Frantz, student from the University, and Vincent Mowbray of Reno. Mowbray, assisted by Richardson, banded 150 White Pelicans on this trip. We are grateful also for the use of unpublished notes loaned by Richardson, Mowbray and J. R. Alcorn. Richardson's notes cover a trip made on June 2, 1950, while those of Alcorn cover trips to the island on June 14 and July 21, 1942, and on May 26, 1944. Mowbray had visited the island on May 22, 1948.

Fig. 2. Young White Pelicans on Anaho Island churning up clouds of foul-smelling dust as they scramble from photographer.

ACCOUNT OF BIRDS

Pelecanus erythrorhynchos. White Pelican. The island is noted for its large White Pelican colonies. After observing the numbers of White Pelicans at Anaho Island in 1924, Hall (1925) stated, "This is, therefore, the largest colony of White Pelicans known

to be in existance today." Anaho Island supports the only known nesting colony of this species in Nevada.

Our visits to the island gave us the opportunity to gather comparative data in two different nesting seasons. In both years the White Pelican colonies were found on the northeast side of the island.

On May 15, 1950, a few large downy young were present in a colony at the shore of the lake. On the successively higher beach levels, extending inland, additional colonies were found. In the uppermost colony, at the base of the cliffs, pipping of eggs had begun. The stage of development of eggs or young in any one colony was fairly uniform, but there was a noticeable difference in the age of the individual colonies, those at higher elevations being progressively less advanced.

By June 26, young from the more advanced colonies were wandering about, and additional colonies had been established on the rocky crest at the summit of the island more than 550 feet above the water's surface. By July 3, practically all of the young had hatched, the colonies at the summit containing new young and a few eggs, some of which were being pipped. In the colonies by the lake the young looked almost like their parents and were already spending part of their time in the water. This was an opportune time to make a count of the young, for hatching was virtually complete, yet none of the young had left the island. On that date a total of 4,160 young was found to be present.

The two visits a year later revealed several changes. For one thing, there was less correlation between nesting progress and elevation above water level. On May 15 a small colony, containing young which were estimated to be about one-fourth grown, was found again at the water's edge. Likewise, pipping of eggs was noted in the nests at the base of the cliffs. Between these two colonies, however, were three colonies in which nest-building and egg-laying had just begun. Adjoining the colony of young at the water's edge was another with eggs in the incubation stage. No nesting took place at the summit.

On the trip in May a nest count was made in all colonies having young and in those where egg-laying appeared complete. On the next trip, in July, a count of nests in the colonies previously omitted was made, thus providing a complete nest count for the year. At the same time a count was made of young pelicans. This count came to 3,742, a reduction of 10 per cent from the 1950 total. The enumeration of pods, or flocks of young, and nesting colonies, also indicated a reduction in the number of young pelicans in 1951, as only 11 pods and colonies were found in comparison with 14 found the previous year. Counts based on groups of young only have little value in themselves, for the delineation of such groups may sometimes be subject to individual interpretation. Some colonies are so closely spaced that question arises as to whether they should not be counted as one. Separation of pods may be difficult, too, particularly when the young are old enough to be active, for the pods tend to break apart or combine with one another in various numerical combinations.

Other pertinent data may be noted briefly. Early-nesting as well as late-nesting colonies were much smaller than those which were established in midseason. The number of young to a pod, as separated by us, ranged from eight to 1,400, and the number of nests to a colony varied from 18 to 2,476. Pods consisting of well-grown young exhibited a tendency to move towards the water upon being approached. One could herd these waddling, stumbling young like sheep.

California Gulls were observed piercing and eating pelican eggs and killing newly-hatched young pelicans. Gulls appeared quickly at nest sites when our intrusion caused adult pelicans to leave.

Various writers, after visiting Anaho Island, have attempted to compare their figures

on number of nests, eggs, young and adults with those of previous observers. We find it difficult to establish any reliable population trend. The principal objection to making a comparison of the population estimates stems from the fact that the various observers visited the island at different times in the nesting season; thus, the colonies were not in comparable stages of development. Some observers apparently counted nests before all colonies were established, and others counted young before hatching was complete or after the more mature ones had left the island. In 1951, nesting was not far enough along to make a complete nest count on May 15. This tabulation was finished, therefore, on July 6. It would have been impossible to have made a complete count on the last date also, for many of the early nests had become unrecognizable.

Short-term fluctuations in population are evident. Our 1950 figures, when compared with those of 1951, indicate that even annual changes may be considerable. Alcorn's data for 1944 vary widely from his 1942 findings.

All available records pertaining to numbers of nests, eggs or young pelicans are summarized in table 1.

Most of the observers of the past made estimates also of the number of adults present. With one exception, however, these estimates do not represent the total adult population involved. We found one adult to be present usually at nests containing eggs or small young. Fewer adults accompanied young which had left the nest. Counts of adults

Table 1

Nesting and Production Records for the White Pelican at Anaho Island.

Observer	Date	Nests	Eggs	Young
Russell	August, 1882			1400
Chapman	1903		139	4000
Evermann	June 3, 1921	2381 occupied		
Hall	June 5 and 6, 1924	4534 occupied	6234[1]	816 in nests
Cooper	June 9, 1932	2994 occupied		300
Bond	June 21 and 22, 1940	100 occupied		3000 one-half grown
Alcorn	June 14, 1942	1761 occupied		1553 in pods
Alcorn	May 26, 1944	4238 with eggs		5417 total
Marshall and Giles	July 3, 1950		16	4160 total
Marshall and Giles	May 15 and July 6, 1951	5650 total		3742 total

[1] Some eggs known to have been destroyed before count.

thus may vary with the season. Hall found that a large portion of the adults spend their day on feeding excursions, which means these birds must also be accounted for before an estimate of the total adult population can be made. After accounting for pelicans he had seen in surrounding areas, Hall estimated the adult population at 10,000 birds in 1924. Assuming two adults to one nest, our nest count in 1951 would place the adult population at 11,300, and it was almost certainly higher in 1950.

An early morning flight of White Pelicans into the Stillwater marsh, 60 airline miles from Anaho Island, is regularly observed during the nesting season. Many other water areas are present within this distance from Anaho and are used regularly by the pelicans. Low *et al.* (1950) observed similar flights into the Bear River marshes from Gunnison Island in Great Salt Lake, Utah.

When disturbed, the young pelicans will disgorge the fish they have recently been fed. This trait gave us the same opportunity afforded to Hall (1925), Bond (1940), and

Alcorn (1943) to determine the species of fish fed to the young. No attempt was made by us to count the total number of regurgitated fish, but this ran into the hundreds. On June 26, roughly 75 per cent of the fish were carp (*Cyprinus carpio*), the remaining 25 per cent being Lahontan tui chub (*Siphateles bicolor obesus*) and cui-ui sucker (*Chasmistes cujus*). One young pelican managed to expell a grand total of 232 carp averaging

Table 2

Returns from White Pelicans Banded at Anaho Island National Wildlife Refuge[1]

Date banded	Date of recovery	Cause of death	Location of recovery
June 21, 1940	October 18, 1940	Killed	Oriental, Puebla, Mexico
"	November 2, 1940	Killed	San Pedro Chico Zapote near Oaxaca, Mexico
"	June 2, 1941	Probably found dead	La Huerta, Michoacán, Mexico
"	December 15, 1944	Found dead	Pyramid Lake, Nevada
"	Letter of April 11, 1946	Unknown	Laguna de San Antonio, County of Rosa Morada, Nayarit, Mexico
"	November 15, 1948	Shot	Coamiles, Nayarit, Mexico
July 3, 1950	September 23, 1950	Shot	Lake Henshaw, Santa Ysabel, San Diego County, California
"	Letter of September 27, 1950	Found dead	Highway 395 near Fish Spring, Inyo County, California
"	October 2, 1950	Shot	Lake Henshaw, Santa Ysabel, San Diego County, California
"	November 3, 1950	Found dead	Near Topaz Lake, Mono County, California
"	June 7, 1951	Shot	Near Guadalajara, Jalisco, Mexico

[1] In addition to the above, three bands were taken from young which died on the island after the 1950 banding. One band, used by Bond in 1940, was also recovered on the island.

about two inches in length. In most instances the regurgitated fish were much longer, ranging usually from seven to fifteen inches in length. The only other species noted on this date was one bullhead (*Ameiurus* sp.). On July 3, 1950, the food picture was completely changed, chubs being the only fish recorded. It thus appears that in order to obtain more comprehensive data on the fish taken through the nesting season, one would have to make many visits to the island. According to Trelease, the switch from carp on June 26 to chubs on July 3 may be correlated with the fact that the chubs of Pyramid Lake become more active at the surface of the water about the first of July.

Strangely, very few fish were regurgitated during the two 1951 visits even though these visits took place at the same time of day as in 1950. The only fish seen on May 15 were two cui-ui, four Sacramento perch (*Archoplites interruptus*), two carp and three chubs. On the July 6 visit, a few carp and one cui-ui were all that were noted.

At the colonies on May 26, 1944, Alcorn (MS) reported seeing 92 chubs, one 14½-inch Tahoe sucker (*Catostomus tahoensis*), one Sacramento perch and four cui-ui, one of which was 21 inches long and weighed four pounds.

The food data correspond closely with those gathered by Hall (1925), Bond (1940), and Alcorn (1943). Since the chub, *Leucidius pectinifer*, is now regarded as a subspecies of *Siphateles bicolor*, and even may not be a valid subspecies (LaRivers and Trelease, 1952), we, like Alcorn, listed all chubs under the latter name. Hall and Bond failed to find cui-ui in the diet of Anaho Island pelicans. Alcorn was the first to list this Pyramid Lake game fish as a food of young pelicans.

On July 6, 1951, Mowbray banded 150 well-grown young pelicans, 50 were banded on July 3, 1950, and in 1940 Bond banded 149 young, making a combined total of 349. At the time of this writing 15 bands have been recovered, all from birds banded either in 1940 or in 1950. Complete data on these returns are given in table 2. A large percentage of the returns have come from Mexico, indicating a migratory pattern similar to that of birds banded at Great Salt Lake. Low *et al.* (1950) reported returns from Mexico for 13 of 23 band recoveries. They found, however, that the birds carry on a northward migration into Idaho before going south. The greatest interval reported between banding and recovery for any pelican at Salt Lake was five years. One of the pelicans banded at Anaho Island by Bond was recovered after a period of eight years.

Fig. 3. A colony of almost fully grown young Double-crested Cormorants. At this stage young often hobble from one nest to another.

On our last visit in 1950 no pelicans were to be seen at the nesting area and 12 were found about the edge of the island. On this date all dead pelicans found were checked for bands. Two bands were recovered from carcasses of young banded on July 3. Banding was not considered a factor contributing to death as both birds were in a more advanced growth stage than when banded.

Human activity may inadvertently cause mortality of young in early growth stages. When approached, the adults leave their young, exposing them to the sun. The naked young seem to shrivel and die quickly from the intense heat if adults are not present to shade them. It appears evident that disturbance in colonies with newly-hatched young should be kept at a minimum and then restricted to the cooler hours of the day insofar as possible.

Phalacrocorax auritus. Double-crested Cormorant. The number of cormorants nesting on Anaho Island has made an exceptional increase since 1940. Four active colonies in 1950 and five in 1951 were located along the east shore immediately east of the pelican colonies. One additional nesting site, containing nests used in some previous year, had been abandoned. The total number of active nests in 1950 was tallied at 1,028 and in 1951 at 1,300. The number of nests to a colony ranged from 124 to 495. A count of young made on July 3, 1950, totaled 1,650. Thirty-four unhatched eggs were left at this

time. On this date, young of all stages were present. Though hatching was not complete in some nests, young birds from others dashed for the water. When the birds were in the water, we experienced difficulty in distinguishing offspring from adults. For this reason, our count of young is undoubtedly low. The visit on July 6, 1951, was too late to permit a census of the young. By that time only 50 remained in the nests.

No hatching had taken place on May 15 of either year. Laying had not yet begun in some nests, although in others clutches appeared complete. The average number of eggs per nest was about four, but as many as eight were noted.

The nests were located on slabs of calcareous tufa and were constructed primarily of alkali weed.

Alcorn (unpublished notes) reported finding 123 cormorant nests at the southeast tip of the island in 1942.

Bond (1940) was the last to publish on the cormorants at Pyramid Lake. He reported seeing 50 nests in 1940 on the southwest side of Anaho Island in a colony of gulls. Hall made no mention of cormorants nesting at Anaho Island. Bond wrote of a report that cormorants were nesting on the Pyramid, which is located next to the east shore of the lake, but we found no nesting there in either 1950 or 1951. It is evident that not only have the numbers of nesting cormorants changed, but colony locations as well.

Hall (1926) and other writers found cormorants and gulls nesting on the Pinnacles, tall spires of calcareous tufa projecting up from the lake bed at the north end of the lake. The Pinnacles are gradually losing their identity as islands, for the retreating waters are leaving them stranded on the shore. Only four are still surrounded by water. On June 27, 1951, observations from the north shore revealed the presence of cormorant colonies on the two largest island spires. Nests and young were clearly seen with the aid of binoculars. It was obvious that their numbers ran into the hundreds. No gull colony was visible. Speaking of the Pinnacles, Bond stated, "I observed no cormorant nests there when I drove by in a car." We found that the colonies were not visible until we had walked about a mile from the road across sandy beaches. We doubt very much, therefore, that Bond could have seen the colonies from his car even if they were present.

On July 3, 1950, we banded 25 almost fully-grown young. No returns have been received to date. On September 21, after the birds had left, a count of dead young was made, and the carcasses were examined for bands. We found 7 of the 25 bands, all on birds that apparently had never left their nests. Banding took place in one colony only, and 22.7 per cent of the nests in this colony contained dead young. In the three colonies where no banding was done the percentages of nests with dead young were 4.4, 7.5 and 8.9, respectively. The noticeably heavier mortality in the colony where banding occurred, plus the fact that almost one-third of the banded birds died, would indicate that the banding operations were detrimental. The exact cause of mortality, though, is not clear. Exposure to the heat would not seem entirely responsible, for young in adjacent colonies also received the same exposure.

The fish brought to young cormorants were of the same species as found in the pelican colonies.

Ardea herodias. Great Blue Heron. Hall (1926) reported finding 10 nests of the blue heron on the northeast side of the island, and Bond reported "About 25 pairs were nesting in the dead weeds along shore on the east side . . . ." On May 15, 1950, we found 10 nests in a heavy growth of *Atriplex* and alkali weed near the cormorant colonies. Small young were present in each. On July 3, two additional nests were found, one with four young, the other with eggs. In 1951, 16 nests were present.

Branta canadensis. Canada Goose. Flocks totaling up to 327 were present in the water around the island on all dates but September 21, 1950. One downy young was

seen on May 15, 1951. Fire, of unknown origin, had burned off a strip of saltgrass on the south side of the island, and 25 geese were flushed from new, green growth in this area on May 15, 1950. Bond found 115 geese using the island for feeding and roosting.

Anas platyrhynchos. Mallard. Groups of from 2 to 13 adults were seen along the island's edges on all trips. One brood of six was observed on July 3, 1950.

Mergus merganser americanus. American Merganser. Commonly seen in numbers up to 25 about the island. Hall (1926) reported this as a species nesting on Anaho Island, and Bond reported seeing 60 males.

Larus californicus. California Gull. Like the cormorants, the California Gulls nesting on Anaho Island have increased in number. On May 15, 1951, we estimated 1,800 adults were present at a colony on a sandy beach on the south shore. A nest count, subsequently made, showed about 1,700 nests to be present. The majority of these nests contained two eggs, though egg numbers varied from one to three, and some nests were merely de-

Fig. 4. Part of the colony of California Gulls on Anaho Island. Note young birds. Photographed July 26, 1950.

pressions freshly made in the sand. Nesting was found to be in this same stage on May 15 of the previous year, but no counts were made. On June 2, 1950, Richardson found one young hatched. By June 26 hatching was practically complete. The site occupied by the colony was crescent-shaped with a maximum length of 800 feet and a maximum width of 450 feet.

Mortality was high. The 1,700 nests counted in 1951 should have produced perhaps 3,400 young; yet on July 6 a careful count showed the presence of only 684 live young. A few of the largest could make short flights at this time, but none was believed to have left the colony.

On July 3, 1950, the largest young were not quite ready to fly. Fifty of these were banded. Again, banding activities appeared responsible for considerable mortality. On September 21 we found the remains of dead young throughout the nesting site; all were of the growth stage earlier observed July 3. Their bodies had largely disintegrated, but dried, dismembered fragments littered the ground. A careful search produced 17 bands; there may have been a few others which we failed to find. The quantity of remains, when compared with the number of young seen on July 3, led us to believe that not more than 100 young birds ever reached the flying stage.

Exposure presumably caused much of this loss. The young gulls, like the young pelicans and cormorants, were protected by the bodies and outstretched wings of their parents. When the parents were driven away, the young soon began to suffer from the heat. The young birds, after being banded, instead of scampering for safety, clustered

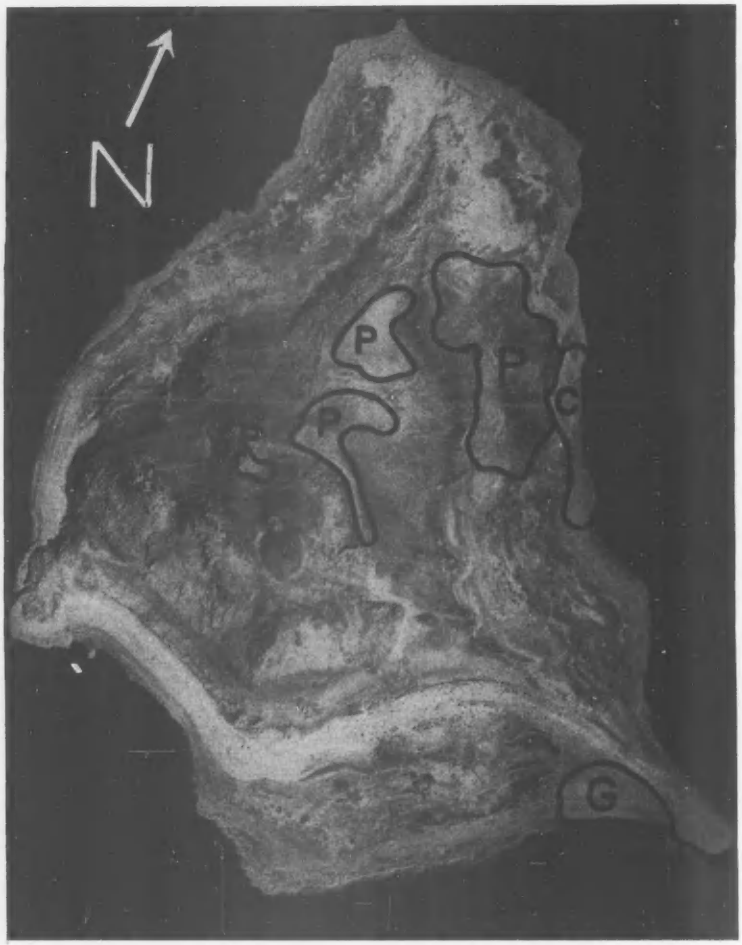

Fig. 5. Aerial photograph of Anaho Island with approximate location of nesting colonies outlined. P = White Pelican; C = Double-crested Cormorant; G = California Gull.

in the shadows cast by our legs or huddled in the shade of a log nearby on the beach. Future banding operations will have to be confined to early morning or late evening hours.

Hall (1926) made no mention of California Gulls nesting at Anaho, but tells of an

estimated 600 adult and immature birds at a nesting colony on the Pinnacles. Gromme (1930) reported finding seven nesting pairs on the island in 1927. Bond, in 1940, found about 200 nesting pairs on the island. He banded 45 young, from which there has been one return, a bird found on July 14, 1942, at Tubbs Island, San Pablo Bay, California. Concerning a trip to the island on July 14, 1942, Alcorn's unpublished notes contain the following statement with regard to the colony. "There were 504 plus or minus nests that contained eggs or small young." Mowbray reported seeing an estimated 1,000 gull nests at the island on May 22, 1948. Thus the colony has grown gradually since 1940.

Hydroprogne caspia. Caspian Tern. Mowbray (MS) with reference to his trip to the island on May 22, 1948, reported seeing about 50 Caspian Tern adults in the gull colony. No evidence of nesting was found, the date being too early. On June 26, 1950, 25 nests and 40 adults were observed in the center of the gull colony close to the edge of the water. Most of the nests contained eggs, very few young having hatched. On July 6, 1951, 15 adults and four young were seen. As near as can be determined, this is the third published record of the Caspian Tern nesting in Nevada. Alcorn (1946) tells of a colony on an island in the Lahontan Reservoir, and Marshall (1951) reported on a colony on an island in the Stillwater Point Reservoir on the Stillwater Wildlife Management Area. Both localities are near Fallon in Churchill County.

SUMMARY

Anaho Island National Wildlife Refuge in Pyramid Lake, Nevada, was visited on six different occasions in 1950 and in 1951. The ornithological data gathered on these trips are presented at this time for the purpose of recording the present status of the nesting populations of White Pelicans and other water birds on the island. The nesting of seven species of water birds is discussed.

Rapidly declining water levels in Pyramid Lake will make the 250-acre island a peninsula in the near future with the probable loss of the nesting colonies.

Nesting colonies of the White Pelican were found on the northeast side of the island at various elevations from the shore to the summit, which was 557 feet above water level in 1950. Nesting extended over such a long period that the earliest young were on the water by the time the last had hatched. A total of 4,160 young was counted in 1950, and 3,742 in 1951. Nests were counted in 1951 only, when 5,650 were found. Recent estimates of this population appear to be as high as, or higher than, any found by observers in the past. Observations of fish regurgitated by the young indicate that fish food consists largely of non-game species. Band returns show that pelicans from Anaho Island migrate to Mexico.

The number of nests of the Double-crested Cormorant increased from a reported 50 in 1940 to more than 1,000 in the years of 1950 and 1951. Four to five active colonies were found on the east shoreline. Mortality was especially heavy in one colony where 25 young were banded. Nesting extended over a long period with the young from some nests being able to swim while hatching in others was incomplete. Large numbers of cormorants were discovered also nesting on the Pinnacles at the north end of the lake.

In 1950 a total of 12 Great Blue Heron nests was found. The number increased to 16 in 1951.

About 1,700 nests of the California Gull were present on the south shore in 1951. This represents an eight-fold increase in the size of the colony since 1940. Mortality of young gulls was high, there being but 684 well-grown young present on July 6, 1951.

Some losses of young of both gull and pelican were attributed, in part at least, to excessive exposure to the sun during the periods when the parent birds were absent because of our activities.

The Caspian Tern is reported for the first time nesting on the island.

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PRECOCIOUS SEXUAL DEVELOPMENT IN THE JUVENAL ENGLISH SPARROW

By JOHN DAVIS

In the course of trapping English Sparrows (*Passer domesticus*) in the Los Angeles area in the summer of 1952, three juvenal males with enlarged testes were taken. Histologic examination of the gonads of these individuals showed that all three were in breeding condition.

In the descriptions of these juveniles, the following criteria of sexual maturity were used:

1. Bill color. The bill of *Passer domesticus* changes from light brown in sexually inactive males to black in breeding males (Keck, 1932:158-159).

2. Size of testes. Measurements of juvenal testes were compared with the following ranges in testis size noted in twelve breeding males in adult plumage and with ossified skulls, collected between June 3 and July 6, 1952: left testis, length, 6–8 mm., greatest diameter, 4–6 mm.; right testis, length, 6–7 mm., greatest diameter, 5–7 mm.

3. Histologic examination of testes. Testes were fixed in Bouin's fluid, prepared by the paraffin method, sectioned at 10 microns, and stained with Harris's hematoxylin and eosin. The histologic stages in testis development outlined by Bartholomew (1949:438) and Blanchard and Erickson (1949:266) were used as standards for comparison.

Descriptions of the juveniles.—Number 14. Live-trapped at 1646 North El Molino Avenue, Pasadena, Los Angeles County, California, on June 21, 1952, by Mrs. Harold Michener. Autopsied June 21, 1952. The skull was completely unossified. The plumage is juvenal except for two white-tipped black feathers on the throat, scattered chestnut and black, or buff and black, feathers on the dorsum and scapular regions, and a preponderance of the lesser coverts chestnut. The maxilla is dark brown, the mandible horn color, tinged and tipped with dark grayish brown. Although not black, the bill is noticeably darker than that of a juvenile with testes measuring 1 mm. trapped on July 6, 1952. The left testis measured 5.5 × 4 mm., the right testis 4.5 × 4 mm. Histologic examination of the testes showed an abundance of mature sperm with corkscrew-shaped acrosomes; the sperm were in bundles located at regular intervals along the radii of the tubules. This condition corresponds to class VI ("full spermatogenic activity with many sperm") of Bartholomew, and to stage 7 ("breeding") of Blanchard and Erickson.

Number 20. Live-trapped at 2134 Brawley Street, Los Angeles, Los Angeles County, California (this locality is 7 miles south-southeast of central Pasadena), on June 22, 1952, by William E. Mannatt and John Davis. Autopsied June 22, 1952. The skull was completely unossified. The plumage is mainly juvenal except for eight white-tipped black feathers on the chin and throat, six fresh gray feathers on the right side of the forehead, scattered buff and black feathers on the dorsum and scapular regions, and a preponderance of the lesser coverts chestnut. The entire bill is black (fig. 1). The left testis measured 6 × 4 mm., the right testis — × 4 mm. (one end ruptured in removal). Histologic examination showed a condition similar to that described for number 14.

Number 22. Live-trapped at 2134 Brawley Street, Los Angeles, Los Angeles County, California, on July 6, 1952, by John Davis. Autopsied July 6, 1952. The skull was approximately one-fourth ossified. The plumage is juvenal except for six white-tipped black feathers on the throat, scattered buff and black, or chestnut and black, feathers on the dorsum and scapular regions, and all the lesser coverts chestnut. The chin feathers are being replaced, and the white tips of the new feathers are visible beyond their sheaths. The entire bill is black (fig. 1). The left testis measured 5 × 3 mm., the right testis 4 × 3 mm. Histologic examination of the testis showed a condition similar to that described for number 14.

DISCUSSION

The presence of juvenal male English Sparrows in full breeding condition during the normal breeding season of the species is difficult to explain. That this is not a local phe-

nomenon is indicated by two juvenal male *P. domesticus* in the University of California Museum of Vertebrate Zoology. Both were collected by the late Joseph Grinnell on the campus of the University of California, Berkeley, California. M.V.Z. no. 8373 is in heavily worn juvenal plumage with a few immature feathers. The specimen label bears the notation in Grinnell's handwriting "♂ jv. (testes very large!)." The bill is not black but dark brown, noticeably darker than the bills of other juveniles collected at Berkeley a few years later. The bird was collected on June 28, 1909. M.V.Z. no. 24758 is about one-third into the postjuvenal molt. Remiges and rectrices are heavily worn. The label bears the notation "♂ jv. Testes large =" and then follows a rough outline drawing of a testis which measures 3.5 mm. in longest diameter. The bill is pale and similar in color to that of the normal juvenile. The bird was collected on June 5, 1914. The advanced stage of molt, pale bill, and moderate size of the testis (if the outline drawing is accurate) suggest that this individual may have actually been in a state of sexual regression when it was collected. The incidence of precocious sexual development in juveniles collected 43 and 38 years ago at a locality over four hundred miles north of Los Angeles strongly suggests that this phenomenon is, and has been, of widespread occurrence in the Californian populations of *Passer domesticus*. It should also be remembered that the three precocious juveniles from the Los Angeles area were taken at localities seven miles apart.

It seems clear that the juvenal testis of the English Sparrow, under natural conditions, can undergo maximal development within the breeding season in which the juvenile hatched. It is to be wondered, then, why sexually mature juveniles do not form a more prominent part of the English Sparrow populations in California during the spring and summer months. Willett (1933:151) gives the breeding season of *Passer domesticus* in southwestern California as "at least from March to July." Grinnell and Wythe (1927:111) give the breeding season in the San Francisco Bay region as "at least from March to August." It is possible that during the nestling period nestlings are shielded from daylight by the location of the nest and brooding by the parents. Witherby *et al.* (1948:158) give the nestling period of the English Sparrow in Great Britain as 15 days. If this period is about the same in California young birds hatched as late as April 15 would leave the nest by May 1. Presumably, such fledglings would be exposed to daylight in the same measure as adults. Thus, by June 21, the longest day in the year, they would have been exposed to some 52 days of increasing day length during that part of the year that includes the longest days in the year. If the pituitary-gonad mechanism of these juveniles responded to photostimulation in the same fashion as this mechanism in adults, we should expect advanced sexual development in juveniles which had left the nest by May 1. Unfortunately, no records were kept of the numbers of juveniles trapped and released by me during June and July, 1952. About 100 juveniles were trapped, of which it may be assumed that one-half were males. Although the bill color of each juvenile was carefully examined before release, no sexually precocious individuals were found other than the three previously described. On the other hand, of 14 adults collected in June and July, 1952, 12 had completely black bills and enlarged testes. Two adults collected on July 7 and 31 were regressing sexually, but testis size and bill color showed that they had been in breeding condition. Two of nine juveniles collected at Berkeley in May and June are precocious, whereas all 15 adults collected at Berkeley during these months are dark-billed.

It seems apparent that sexually precocious juveniles exist in low numbers during the spring and summer months. This suggests that the juvenal pituitary, or testis, or both, differ markedly from those of the adult in their response to the stimuli leading to sexual development. What these differences are has not been established. However, Kirsch-

baum *et al.* (1939:255) state that the "testes of juvenal males are apparently capable of responding to gonadotropic substance at any time after hatching. Complete spermatogenic activity was induced by injections of pregnant mare serum during May and any time thereafter." The same authors (*op. cit.*:251) present in tabular form data showing that four male English Sparrows captured at New Haven, Connecticut, and aged by them as "fledglings," received daily injections of pregnant mare serum during May over periods ranging from 16 to 27 days. At autopsy, the bills of all individuals were black, the gonads were termed "active," and averaged 5.5 × 4.5 mm. These findings would

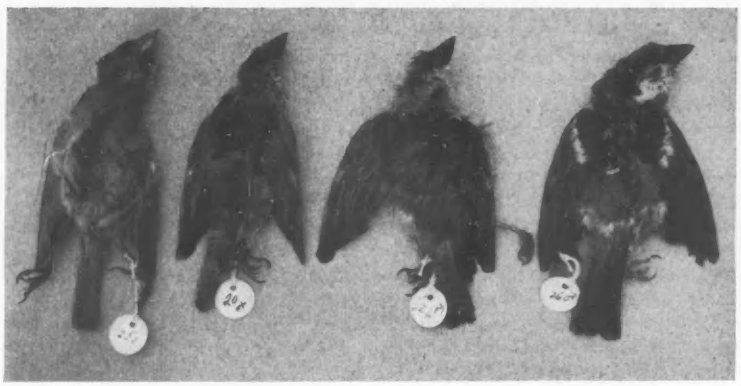

Fig. 1. Bill color of male English Sparrows. Left to right: normal juvenile no. 25, sexually mature juveniles nos. 20 and 22, and breeding adult no. 26.

indicate that the juvenal testis is capable of response in much the same fashion as the adult testis, and that it is the pituitary that is refractory.

The worn condition of the plumage of four of the five precocious juveniles discussed in this study suggests that they were hatched early, possibly during the late winter. It seems significant that of the three juveniles from the Los Angeles area, number 14, which has the least darkened bill, has only moderately worn plumage, whereas numbers 20 and 22, both black-billed, have heavily worn plumage, suggesting that they were fledged at an earlier date than number 14. Although the breeding season starts in California in March, it is not unreasonable to assume that there are occasional broods raised in January and February. Witherby *et al.* (*loc. cit.*) state that the breeding season begins in May in Great Britain, but that fresh eggs may be found "exceptionally in almost every month." Cottam (1929:193-4) reported a successful nesting at Provo, Utah, on January 1, 1929, with temperatures near 0°F. and snow on the ground. He also reported three nestings at the same locality in March, 1929, with subzero temperatures and heavy snowfall during that month. In the relatively mild climate of coastal California, it seems probable that some nesting occurs in the late winter months in that area. In my opinion, sexually precocious juveniles exist in low numbers because they result from sporadic breeding occurring well before the greater part of the English Sparrow population engages in nesting activity. I further believe that the pituitary of the juvenile is in some way less responsive to photostimulation than is that of the adult, and that only those juveniles hatched in the late winter, near the beginning of the period of increasing day length, will eventually be brought to a marked degree of sexual development.

It seems unlikely that sexually precocious juveniles form a part of the effective breeding population. First, there are obvious differences in plumage pattern and coloration between juveniles and adults, and these might well preclude the former from attracting mates. Second, there may possibly be behavioral differences between young and old birds which would be equally important in this regard. For example, of several hundred English Sparrows trapped between June and November, 1952, only a small proportion was adult. This extreme wariness on the part of adults has been encountered by others engaged in trapping this species and indicates that there are rather important behavioral differences between age groups.

Experimental zoologists working with samples of juvenal English Sparrows, especially in the warmer parts of the country, should realize that their supposedly pure samples of juveniles may include occasional individuals which have reached sexual maturity. Such birds would react to experimental manipulation as adults rather than as juveniles. Molting and black-billed juveniles should be eliminated from samples taken for experimental purposes during the spring and summer.

The problem is more difficult in the fall and early winter. There is no plumage character that will consistently separate adults from immatures when both are in fresh plumage. It is also possible that birds hatched as early as January and February might have fully ossified skulls by early fall, so that this criterion might not achieve complete separation of age classes. If the skulls were still not completely ossified, birds with a history of precocious sexual development could not be separated from normal immatures. It is suggested that, if occasional juveniles or immatures respond abnormally to experimental manipulation, the gonads of these birds be examined histologically to determine whether they resemble the gonads of adults taken at the same time of year.

I wish to express my thanks to Mrs. Harold Michener and William E. Mannatt for assistance in trapping. Specimens of *Passer domesticus* in the Museum of Vertebrate Zoology were made available through the courtesy of Dr. Frank A. Pitelka. My wife, Dr. Betty S. Davis, assisted with the microtechnique involved in this study.

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Moore Laboratory of Zoology and Biology Department, Occidental College, Los Angeles, California, November 18, 1952.

LIFE HISTORY OF THE SOUTHERN HOUSE WREN

By ALEXANDER F. SKUTCH

From Canada to the Strait of Magellan, House Wrens are so widely distributed over the American continents that scarcely anyone who has given attention to ornithology anywhere within this vast area will need an introduction to them. Wherever he meets them, the bird-watcher finds these active small birds so similar in their brown plumage, barred on wings and tail, and so much alike in voice and mannerisms, that he is inclined to question why systematists should place the House Wrens of temperate North America in one species (*Troglodyltes aëdon*), and those spreading over the extensive region from southern México to Patagonia in another (*T. musculus*). The modern classification of birds includes in the same species many wrens whose coloration differs far more strikingly than does that of the two House Wrens. Differences in the lengths of wings and tail are now used to keep *Troglodytes aëdon* distinct from *T. musculus* despite the many reasons which might be adduced for joining them more closely in our systems of taxonomy.

In Central America, Southern House Wrens are found almost everywhere, from sea-level up to 9000 feet in both Guatemala and Costa Rica, and in arid no less than in excessively rainy districts. As with a number of other species, a wide latitudinal distribution is matched by a wide altitudinal one. These wrens seem to be somewhat more abundant in the interior than on the coasts, probably because at moderate elevations in Central America man has more thoroughly cleared the land and raised more buildings. The House Wren occurs near rural houses and in plantations, pastures, cornfields, and other clearings where dead trunks and decaying stumps provide sites for their nests. I have never once seen the bird in the unbroken forest, or even amid the heavier second growth vegetation. It prefers the open conditions created for it by the activities of man. It is never gregarious. As a rule the young separate from their parents soon after they can take care of themselves, while the adults remain paired throughout the year. I have never known two pairs of House Wrens to share the same house and dooryard. In the tropics, at least, the Southern House Wren appears to be permanently resident wherever it occurs.

FOOD AND FORAGING

So far as I have seen, the House Wren takes only animal food. It enters rustic buildings where everything is quiet, to flit and hop over the exposed beams and rafters, plucking spiders from their webs and brown cockroaches from dark crannies. Wood piles, stone piles, and heaps of brush are attractive to these secretive birds, which hop and creep through all their interstices in search of food. Gardens, weedy fields, low thickets, and patches of tall grass are explored, the wrens usually hunting out of sight amid the dense herbage, often upon the ground, over which they hop or advance with a few slow walking steps. Sometimes they climb up the trunks of trees with rough bark, ascending somewhat sideways rather than with the body quite upright like a woodpecker or a creeper, and plucking out the small invertebrates from the crevices. Important in the diet of the House Wrens are small grasshoppers, spiders, cockroaches, and hairless caterpillars. A complete list of species eaten by them would be long. It is significant that not once in ten years have I seen a House Wren visit the feeding shelf close beside my house in Costa Rica, where birds of many other kinds come to eat bananas.

VOICE

Except while molting, the House Wrens of Central America sing more or less throughout the year, but most freely during their long breeding season. The song of the male is a bright, swift outpouring of liquid notes. It takes a number of forms and

is always so rapid that I have never been able to paraphrase it in syllables adapted to the human tongue. Chapman (1929:67) considered the song of this House Wren, as he heard it on Barro Colorado Island in the Panamá Canal Zone, superior to that of its North American counterpart; he states that the song of the former is "louder, more musical, more varied, and longer than that of the northern bird. Sometimes I hear in it a suggestion of the Song Sparrow's song; at others it has a trace of the lyrical quality of the lay of the Vesper Sparrow." Other ornithologists, however, have held the Southern House Wren's song to be inferior to that of its North American relative. Since the songs of both species vary a good deal with locality and with individuals, both judgments may be correct in relation to the particular wrens which one has heard. At times, especially after the close of the breeding season, Southern House Wrens sing softly in an undertone, employing all the figures of their usual song, but in a voice so low that they can be heard only when close at hand.

With a number of tropical wrens, the song of the female is nearly or quite as rich and varied as that of the male. In the House Wren, the voices of the two sexes differ more strikingly than in any other tropical wren that I know well. Although the female has no vocal expression comparable to the full song of the male, she does—in some individuals at least—possess a little utterance which I believe must be dignified with the name of song. This is a low, rapid *twitting*, following at times by a slight, clear trill. Exceptionally the female has a rich, full, resonant trill; one individual with such a trill did not use the preliminary twitter. As other wrens of which the female is vocally more gifted perform either synchronous or antiphonal duets, so the female House Wren sings her little song chiefly in response to the richer, fuller verses of her mate, rarely when alone. Chapman's observations on the song of the female House Wren in the Canal Zone are in agreement with my own made both there and in Costa Rica. He writes (1929: 67, 68): "She is not a soloist and, as a rule, gives voice only when she hears the song of her mate. He may be with her or a hundred feet or more away. When he sings she sits with fluttering wings uttering a *twit-twit-twit-twit-tee-tee-tee* with enough musical quality and volume to deserve the name of song. Generally she keeps time with her mate, sometimes she is a little ahead, reacting perhaps to his opening notes that I may not have heard; sometimes she is a little behind him."

The House Wren's expression of alarm is well written by Chapman as "a grating *cloudy-ditch, cloudy-ditch,* quite unlike, therefore, the northern bird's more simple *cacking*." It gives voice also to a variety of churring, burbling and rattling notes, which become harshly grating when its nest is molested. Older nestlings raise a loud sizzling noise when food is brought to them. Fledglings utter nervous little *tuc* and *churr* notes.

SLEEPING

Many if not most of the wrens of tropical America, and at least some of those which inhabit the temperate regions, roost in sheltered places, either in nooks and crannies which they find ready-made or, more often, in roofed nests of their own construction. The Southern House Wren takes shelter for the night in holes such as it uses as sites for its nest. Adults as a rule sleep singly, although I have known a male to roost in a gourd where his mate was brooding nestlings, and another whose mate vigorously resisted his attempt to join her in the evening in the nest-box which their young had just left. Young newly emerged from the nest are led by their parents to pass the night in some sheltered nook, sometimes back into the nest-cavity itself, but more often elsewhere. Here they may sleep either in company with the female parent or alone. Occasionally the fledglings are taken to sleep in a fairly exposed position, as in the open, cup-shaped nest of some other bird, or in a thick crotch in the midst of clustering foliage.

I have known House Wrens to continue for a number of months, until long after they were full grown and independent of parental care, the habit of sleeping exposed to the rain, to which they had been early accustomed under parental guidance.

Some of the places where I have found Southern House Wrens lodging are old woodpecker holes high in dead trees; natural cavities in trees and posts; niches or short burrows in vertical banks (not made by wrens); in the eaves of a house; between the tiles of a roof and the wooden supporting strips; in pockets among the leaves of thatched roofs; in the hollow end of a bamboo cross-piece of a garden trellis; in the center of a bunch of green bananas hanging from the plant. House Wrens are weak flyers, and when going to roost in a high woodpecker hole they seem unable to reach the doorway by a single direct ascent but must work their way up the long trunk in stages, clinging to the side after each short upward flight. This I have often watched them do in the evening twilight. As a rule, holes used for sleeping contain no lining taken in by the wrens.

In many of the situations listed above, it was not practicable to visit the wrens during the night and see how they slept. Those which I could examine took shelter in shallow niches in the cut banks of a private roadway winding among open pastures and woods of oak and pine, in the Guatemalan highlands nearly 9000 feet above sea-level. In March, 1933, walking along the unpaved road, I found nine House Wrens sleeping in such niches, illuminating them with an electric torch. The tenant of each niche slept with its head at the end of the short tunnel, its tail toward the outside. All the body feathers stood on end, revealing light spots toward their bases that were ordinarily concealed. These made the little bird's back appear to be mottled with white. It was impossible to distinguish any trace of a head in the little ball of downy feathers; the barred brown tail alone was well defined, projecting on the side toward me. The tuft of feather-down pulsated with the rapid breathing of the little body as its center. Williams (1941: 278) described and figured similar light spots in the plumage of sleeping Bewick Wrens (*Thryomanes bewickii*).

In the morning, the male House Wren usually arises a little earlier than his mate and begins his day with song. The female may emerge from her separate niche near by as soon as she hears his voice, or she may linger a few minutes longer, rarely as many as ten, whereas in the evening she retires a little earlier than the male. These statements refer to periods when she is neither incubating eggs nor brooding nestlings. Only rarely is the order of arising and retiring reversed. In a number of other species of diurnal birds, earlier arising and later retiring by the male of the pair have been recorded (Nice, 1943:111).

NEST-BUILDING

The breeding season of the House Wren is remarkably long, even for a tropical bird. Writing of *T. musculus clarus* in Trinidad, Belcher and Smooker (1937:508) state: "The nesting season for this, almost alone of local birds, may fairly be said to be the whole year; but no doubt its height, as for most passerines, is in May." On Barro Colorado Island, Chapman (1929:68) found a nest which in early January contained four eggs. In the valley of El General in Costa Rica, I have known the House Wren to build during the second half of December, and to complete a set of four eggs before the end of the month. This is unusually early; but I have a record of a nest from Pejivalle on the Caribbean slope of Costa Rica which must have been begun in January (it contained newly hatched young on February 6) and a number of records of building and even laying in February. These early nests were active during the drier months. By March, when the short dry season of southern Costa Rica draws to a close, the nesting operations of the House Wren have reached their height, and they continue for the next six or seven rainy months. I have several records of August nests and one of laying in

mid-September, which was not a successful nesting. October and November are the only months in the year in which I have seen no evidence of breeding in Costa Rica, but Richmond (1893) observed them building in Nicaragua in November.

The House Wren's wide range, both latitudinal and altitudinal, and long breeding season are matched by its amazing variety of nest-sites—three marks of a highly successful species. Almost any nook or cranny of the proper size, above or below the ground, in natural objects or the artifacts of man, may be chosen to contain the nest, as described above.

Although the nests are usually situated where sheltered from the rain, I have found them in the deep central cavities of decaying palm or hardwood stumps, and in the central hollow of a timber bamboo, open to the sky although completely walled about the sides. Nests are rarely very high, about 15 feet above the ground, in a roof, bird-box, or bunch of bananas being the loftiest I have seen, although Harrower (1936) records a nest 30 feet above the ground in a steel railroad signal tower. I have known wrens to sleep in woodpecker holes far higher than I have ever found them nesting. Doubtless the difficulty in carrying up the multitude of sticks they use in building sets a limit to the height of the nest.

The space chosen for the nest is filled almost to capacity with coarse twiglets, straws, and similar materials. Male and female share this labor about equally, although the former is often the most energetic when the task of carrying in coarse material begins but leaves to his mate most of the finer work of applying the lining. While building he sings frequently, doing so even as he carries a stick in his bill. If the cavity to be filled is spacious, a great bulk of this material is brought. In the difficult feat of passing long sticks through a narrow aperture already partially blocked by the protruding ends of earlier acquisitions, the female of one pair was somewhat more dexterous than her mate; but another male displayed much skill in this fussy business. The trouble is that the wrens try to pass through the doorway while grasping the stiff pieces near the middle and both ends are stopped by the surrounding rim. Sometimes while struggling with the stick they get a hold toward an end and it slips through, but often the piece slips from their bills and drops to the ground. As a rule, the birds fail to retrieve this fallen material; but its loss affects the male little and he continues to sing, flying off to search for new pieces. Often when he brings nothing himself he goes to the doorway, always singing, to look in when his mate is inside.

While one female built her nest on a shelf formed by the foundation beams beneath a cabin set on posts on Barro Colorado Island, her mate busied himself in piling sticks on the top of a round tobacco tin standing on the beam at the opposite side of the house. Here he placed all the material that the narrow lid would hold, which was not nearly enough to complete a nest. Rarely he carried a stick to his mate's accumulation. Such divergence of activity of the male and female House Wrens is most exceptional in my experience.

At the top and back of the mass of sticks that serves as a foundation, the wrens leave a deep hollow, to be lined with fine grasses, fibrous rootlets, pine needles where available, vegetable fibers, horse hairs, and innermost of all, downy feathers, pieces of snakeskin, and, at times, even scraps of cellophane or paper. The lining is applied chiefly if not wholly by the female, while her mate continues to sing and to fetch superfluous sticks that get in her way. She struggles to arrange these unwanted contributions of her partner, and at times she may deliberately carry some of them away. One female drove off her mate whenever he approached with unwanted sticks and even pulled a feather from his back when he entered the box while she lined it. At other times the male may fetch flexible material for the lining, yet his inclination to bring stiff sticks at all stages of the building process is strong.

A large gourd, from which I had removed all material after a first nesting, was in less than four days filled to above the level of the door sill by both sexes working together. Then the female devoted four or five days more to lining the nest, making a total of about eight days for the whole construction. But another pair filled a nest-box and applied the feather lining in only four days. Even while she incubates, the female gathers downy feathers or fragments of snakeskin and brings them to the nest when she returns to her eggs. Before the nestlings hatch most nests are profusely lined with feathers, the innermost placed so that their distal ends curve inward over the eggs and make them hard to see.

THE EGGS

The earliest set of eggs for which I have a record was laid in El General between December 27 and 30, 1936, but sets before late February or March are not common in Costa Rica. Even when she sleeps in the nest before or during the period of laying, the female seems to leave at dawn, but soon returns to deposit her eggs, which are laid early in the morning on consecutive days. Nineteen eggs, of which I determined approximately the hour of laying, appeared before 7:00, and at least 13 of these before 6:30. The interval in which the eggs are laid extends from a little before to a little after sunrise. Although with the domestic hen and some other birds each succeeding egg in a series is laid a little later in the day, this is not true of the House Wren, which tends to lay all the eggs of a set at about the same hour of the morning (see Skutch, 1952:53). In Central America the usual set consists of four eggs, with three frequent and five very rare. From Costa Rica, Guatemala and Panamá I have records of one set of two (perhaps incomplete, although no more appeared in the nest), 13 sets of three, 22 sets of four, and two sets of five (both laid apparently by the same female in consecutive years). In Trinidad the usual set of the House Wren consists of four or five eggs, and there is a record of one nest with "eight eggs of equal incubation, which might all have been laid by one bird" (Belcher and Smooker, 1937:509). Beyond the tropics, in Argentina, this wren is said by Hudson (1920:18) to lay sets of nine eggs, a surprisingly large number.

Although in Costa Rica the House Wren may rear four broods in a year, the size of the set bears no relation to its order in the sequence of nests. On several occasions sets of four were followed by sets of three; and the two sets of five were both found in late nests. Chapman (1929:70) tells of a bird-box with two nests of the House Wren each containing eggs. There had been two pairs of wrens in the vicinity, but no study was made to determine whether both nested in the same box. House Wrens are so strongly territorial and so intolerant of trespassers, that this would be a most unusual situation.

The eggs of the House Wren are rather short and blunt. They have a whitish ground color which is densely flecked all over with fine markings of brown, reddish-brown, cinnamon, or pinkish-cinnamon. On some the pigmentation is heaviest on the thicker end; on others it is nearly uniform over the entire surface and almost obscures the ground color. Thirty-nine eggs measured at the nest in Central America average 17.8 by 13.4 millimeters. Those showing the four extremes measured *19.4* × 13.5, 17.9 × *13.9*, *16.7* × 13.5, and 17.1 × *12.7* millimeters.

My only considerable number of nests from a single locality are from the Basin of El General in southern Costa Rica, between 2000 and 3000 feet above sea-level, and were found during the years 1936 to 1951, inclusive. Eggs were laid in 44 nests as follows: December, 1; February, 4; March, 7; April, 9; May, 6; June, 5; July, 7; August, 4; September, 1.

INCUBATION

The eggs are incubated by the female alone. Although similar in appearance, it is easy to distinguish the sexes during the nesting season by their voices, and at one nest

favorably situated for observation from my window, I could often distinguish the two by their bills, the lower mandible of the male being extensively yellowish or horn-color, that of the female largely black.

Attendance at the nest by night may start before or after laying begins but, in my experience, always before the set is completed. Sometimes the female wren uses the nest cavity as a dormitory even before she and her mate begin to build in it. At Nest 30 she slept in the nest-box for at least three weeks before the pair began to take in sticks for their first nest of the season and continued to do so during the period of building. Thrice I have known the female to sleep in the nest with fledglings before beginning to lay the eggs for the following brood; the family continued this custom during the period of laying and subsequent incubation. In all, I have recorded nine instances of the female's occupying the nest by night before beginning to lay. In four instances the female began to spend the night in the nest after laying her first egg. At one nest she did not begin to do so until after the second of the four eggs was laid. At one nest, the female's behavior was irregular: she slept in the nest-gourd on the night of June 3-4, but not on the two subsequent nights. On the morning of June 6 she laid her first egg, then resumed the practice of sleeping in the gourd. The warming which the early eggs receive before the set is complete is reflected in the time of hatching, which is sometimes spread over two days.

By day, the House Wren is an impatient sitter. I watched one wren while she incubated her first set of eggs. During six hours she took 12 sessions, ranging from 8 to 20 minutes in length and averaging 14.1 minutes; and 12 recesses, varying from 11 to 24 minutes in length and averaging 15.7 minutes. Thus she spent only 47.3 per cent of the six hours on the eggs.

This same wren, nesting in the same gourd, sat more closely while I watched her incubate her third set of eggs later in the year. Now, during 9.5 hours, she took 14 sessions, ranging from 14 to 44 minutes in length and averaging 25.8 minutes; and 14 recesses ranging from 8 to 29 minutes in length and averaging 14.4 minutes. She devoted 64.2 per cent of the 9.5 hours to incubation.

Some years later I watched another wren incubate the eggs of her third brood when they were on the point of hatching. During six hours of the morning she took 11 sessions, ranging from 5 to 26 minutes in length and averaging 19.6 minutes; and 11 recesses, ranging from 6 to 18 minutes and averaging 11.4 minutes. She was in the nest-box for 63.3 per cent of the 6 hours. During 21.5 hours of watching at three nests, the longest continuous session on the eggs was 44 minutes, the second longest 35 minutes.

Other species of *Troglodytes,* as the North American House Wren (Baldwin and Kendeigh, 1927:213) and the European Wren (*T. troglodytes*) (Armstrong, 1952:229) are equally restless sitters. A Highland Wood Wren (*Henicorhina leucophrys*) which I watched for nine hours took sessions ranging from 8 to 28 minutes, with an average of 16.4, and covered her eggs only 49.4 per cent of the time. But wrens of other species may incubate far more steadily. For the Lowland Wood Wren (*H. leucosticta*) and the Riverside Bay Wren (*Thryothorus nigricapillus*), which I watched for 7 and 3½ hours, respectively, the only sessions timed were in excess of one hour. Nice and Thomas (1948:142-146) found the Carolina Wren (*Thryothorus ludovicianus*) an extremely steadfast sitter, often remaining on the eggs for two hours or more without interruption.

While the female House Wren incubates, her mate is usually attentive, singing profusely in the vicinity, sometimes escorting his partner when she returns to the nest, driving off intruders, and from time to time entering the nest-cavity or at least putting his head through the doorway. But I have not seen him give food to his mate before the eggs hatched, as happened at one nest of the related Rufous-browed Wren (*Troglodytes rufociliatus*) in the Guatemalan highlands.

At one nest, an incubating female would leave the nest, pause a short distance away, and voice a fine resonant trill in answer to the mate, which was usually singing not far off, relaxing and fluttering her wings as she trilled. At another nest situated beneath the tiles of my roof, I would sometimes hear the female sing a little twittering song to herself while she incubated.

At a single nest at an altitude of 8500 feet in the Guatemalan highlands, I found the incubation period to be 17 days. At 13 Costa Rican nests, situated between 2500 and 3000 feet above sea-level, the incubation period varied from 14 days, 9 hours (±3 hours) to 16 days, 2 hours (± 2 hours). At eight of these nests the period fell between 14½ and 15½ days, and the average length of the incubation period might be stated as 15 days. At nests where the eggs were not marked in the order of laying, I considered the incubation period to be the interval between the laying of the last egg to be laid and the hatching of the last egg to hatch. When the eggs were marked, the period was taken to be the time between the laying of the last egg and the hatching of this egg. At six nests where the eggs were marked as laid, the last to be deposited was also the last to hatch; and I have noted no exception to this rule.

The three or four eggs which constitute the set do not hatch simultaneously. When daily visits are made to the nest, some of the eggs will be found to have hatched on one day and the rest the following day. More rarely the hatching is spread over three days. At nest 25B, where visits were made more frequently, the first egg (of the set of four) hatched about 12:30 p.m. on July 24 and the last, as indicated above, between noon and nightfall of the following day. At nest 27, all three eggs hatched within a period of 21 hours or less. At nest 29A all three hatched between 8:15 a.m. and 5:00 p.m. on the fifteenth day after the last was laid—that is, within nine hours. The eggs may hatch at any hour of the day. With a single exception, eggs have hatched in the order of laying. Empty shells are carried away by the female wren.

CARE OF NESTLINGS

The nestlings begin to receive food soon after they hatch.

At 12:28 p.m. on July 24, 1944, I found the first egg hatching in a nest-box in my yard. The nestling was just squirming out of the broken shell, of which the cap had already been removed from the nest. At 12:42 the female flew off with the main part of the shell. The male, who during the course of the morning had thrice entered the box, went in again at 12:35 while the female was within, probably brooding. It is doubtful whether at this visit he saw the contents of the nest. He came out in less than a minute. At 12:43 he followed his mate into the box as she returned from another outing and stayed within for two minutes, probably viewing for the first time the first nestling. At 12:53 he returned with a very small insect, apparently passed it to his mate on the nest, and sang. Thus, food was brought for the young wren within about half an hour after it hatched. Four minutes later the male brought food the second time, then took in a number of morsels at intervals of a few minutes. No food was seen in the female's bill until 2:06, 73 minutes after the male first brought a morsel. Before this she had carried away the empty shell of the second egg, and the male had brought food seven times.

The following March 24 I watched events attending the hatching of the nestlings at this same nest-box, presumably with the same pair of House Wrens. The eggs began to hatch during the night, and before sunrise the female had carried out at least three pieces of shell. She first brought food at 5:50, 20 minutes after she became active in the morning. By 10:40 that morning the male had not yet taken a morsel into the nest, where there were now three nestlings. The delay in bringing food did not arise from any lack of attention to the nest, for during the first four hours of the morning he entered the nest-box seven times. On six of these visits he found his mate within, presumably covering the nestlings. (Female passerine birds, as I have seen at nests of a number of kinds, do not as a rule make any special effort to "inform" their mates that their eggs have hatched.) But at 8:41 the male went into the box while the female was absent and remained for about two minutes. Then for two hours following this long visit he brought no food; this makes it seem probable that he was still unaware

that the nestlings had hatched, for with other birds that I have studied at this critical period in the history of the nest, the sight of the nestlings led more promptly to the bringing of food. During the latter part of the same day, or at latest early the next morning, the male wren learned of the existence of the nestlings; by seven o'clock on their second morning of life he was bringing food to them.

In my experience, the male House Wren, as a rule, begins to take a full share in feeding the nestlings by their second day, at the latest.

So far as I have seen, the nestlings are given only small invertebrate animals, conspicuous among which are spiders, hairless caterpillars, small grasshoppers, cockroaches, and moths. At times several insects are brought at once. Male and female take substantially equal shares in feeding the nestlings, sometimes one, sometimes the other making more numerous visits to the nest during a period of observation. The male often sings as he approaches with a full bill.

At times the parents are aided in attending the nestlings by youngsters of the preceding brood. I have seen this with only one pair, and in only one of the two years in which I studied this pair; but during the second year it was regular, juveniles of the first brood helping to feed the nestlings of the second, and these in turn, after they were grown, bringing food to the nestlings of the third brood.

Rates of feeding are rather variable. At one nest the male, in an initial spurt of activity, brought food seven times during his first hour of feeding. At the beginning of this hour there was one newly hatched nestling, at the end two. It is possible that the female, sitting on the nest, consumed part of this food herself. During the following hour, the male brought only two morsels to the two nestlings, the female only one. At another nest where the male was tardy in beginning to feed, the female brought food 17 times during the first five hours of the day. At the beginning of this period there were two newly hatched nestlings, but during the last three hours there were three.

Two nestlings three days old were fed ten times during two hours, or at the rate of 2.5 times per nestling per hour. Nestlings from 9 to 18 days old have been fed at rates varying from 4.3 to 8.4 times per nestling per hour, during observation periods of from three to four hours. These were in broods containing three or four nestlings.

In Surinam, Haverschmidt (1952:295) found feeding rates of the Southern House Wren to vary from 2.8 to 5.3 times per nestling per hour, with little change in rate as the young aged from 5 to 14 days. With my wrens, a single nestling attended by an older brother and sister as well as its parents was fed at greatly varying rates. During four hours on its eleventh and twelfth days, the four attendants brought food only 11 times, or 2.8 times per hour; but on the thirteenth day three attendants brought food 31 times in 2.5 hours, or 12.4 times per hour.

The female alone broods the nestlings. At one nest the female greatly increased her time on the nest just after her first egg hatched, when her mate was bringing food at a rapid rate, probably in excess of the nestling's needs. The first egg had hatched soon after noon. During the six hours preceding the hatching, the female had incubated 63.3 per cent of the time. But during the 2.25 hours following the hatching of the egg she brooded 90.4 per cent of the time, once for 35 and once for 29 minutes continuously. During the morning her longest session had been 26 minutes. Her longest absence was now only four minutes, although before the eggs hatched her recesses had varied from 6 to 18 minutes in length and averaged 11.4 minutes.

At a second nest, during the first five hours of the morning when the eggs hatched and when the male still brought no food, the female brooded 21 times, for periods ranging from 2 to 21 minutes and averaging 9.2 minutes. Her 21 absences varied from 1 to 16 minutes and averaged 5.4 minutes. She brooded 63 per cent of the five hours. Thus her total time on the nest was about the same as that observed at other nests during the

course of incubation; but she came and went much more frequently, both her sessions and recesses being from one-half to one-third as long as those recorded for incubating House Wrens.

The nestlings are brooded, by day, in decreasing amounts until they are 9 or 10 days old, when their feathering is well advanced. In one instance, the female brooded the nestlings by night only until they were 13 days old; but two other female House Wrens continued to keep their young company through the night until they were 18 days old.

Nearly all the House Wrens that I have studied nested in cavities with such narrow entrances that it was impossible actually to watch the nestlings. But in 1937 I had a nest in a gourd with a wide round doorway. While the young were growing up, I moved this to a position where from my window I could look right into the cavity and see the four little wrens resting in their dimly lighted nest. I wished to learn whether there was any arrangement to ensure the equal partition of food among the several youngsters.

The instant one of the attendants reached the doorway, four widely opened orange-yellow mouths were stretched eagerly forward to greet it. As soon as it alighted upon the door sill, the parent placed the insect or spider it had brought into one of the four mouths which gaped so prominently in front of it, probably the nearest, if there was any choice in this respect. There never seemed to be a moment's hesitation which might indicate a weighing of claims of the several young. Nor did the parent remove food from the mouth of a nestling who was sluggish in swallowing it, to place it in another's, as birds which rear their families in open nests commonly do. Probably because House Wrens so often nest in dark crannies where it is difficult to watch the food disappear, they have not adopted this method of equitable distribution among the members of the brood. With this same species in Surinam, Haverschmidt (*ibid.*:294) likewise found that at each feeding visit all the food was delivered to a single nestling.

Thus, when the nestlings were all very hungry, and all equally prompt in opening their mouths upon the arrival of food, it seemed largely a matter of chance which received the nourishment. But later in the day, when they were well fed and feeling drowsy, the one whose hunger happened to be the sharpest was usually the most alert, and the first to stretch forward its open mouth; and almost always this one was fed. It frequently happened that a second or two after the parent had reached the doorway, all of the nestlings had become aroused and clamorously pushed forward their open mouths; but by this time the wide-awake nestling had already swallowed the food brought. Thus the very rapidity with which the parents delivered the food tended to equalize its distribution among the members of the brood. The sizzling chorus of *cheeps* that issued from the gourd each time food arrived was made chiefly by those nestlings who failed to receive it; the one whose mouth was filled promptly became silent.

Only three of the four young wrens could find room in the front of the nest; and of these three one was usually forced to remain well to one side of the doorway. The fourth had to be content with a position in the rear, where it looked over the heads of its nest-mates. When hungry, it struggled from time to time to push into the front row; and in the end these periodic struggles would result in a shifting about of positions. In order to deliver a dropping into the bill of a parent, the nestling had to turn quite around. This was a frequent cause of rearrangement, because before the youngster could face forward again, it was likely to be pushed aside by an eager nest-mate.

At the age of twelve days, the young were well feathered and began to preen their fresh plumage. When fifteen days old, they would sometimes venture beyond their nest into the forward part of the gourd; and by the following morning some had become bold enough to push their heads through the doorway and look around for the approach of their attendants with food. They had begun to peck at spots, or perhaps small crawling

insects, which attracted their attention within the gourd. When an insect flew past their doorway, two which had been looking out made a move to snap it up in their bills, but were not quick enough to catch it. But it was interesting to see that even before leaving the nest they had begun to look for food for themselves. Now some of them perched on the rim of the nest to sleep, like grown birds, instead of crouching down in the hollow for the female to brood them, as they had done when younger. The female ceased to sleep in the gourd several days before the nestlings were old enough to leave it, but an older brother continued to keep them company during the night.

DEPARTURE OF YOUNG FROM THE NEST

Young House Wrens as a rule leave the nest on the eighteenth day after hatching. I have records of 26 nestlings in 11 nests that left at this age. Less frequently they depart on the nineteenth day; 12 nestlings in seven broods took leave at this age. One nestling left, in company with three older ones, on the seventeenth day. One exceptional youngster, in a nest where apparently only two eggs were laid, lingered until the twentieth day after hatching. If disturbed, however, the young may quit the nest sooner. From a nest which was molested by some school-children, the four young wrens were frightened into the open when 17, 16, 16, and 15 days old, respectively. As a rule, the fledglings leave the nest during the forenoon, usually rather early in the morning. The most common time of departure is around seven o'clock in the morning, after the young have been well fed by their parents; but from one nest all three flew before 6:06 a.m.

Despite their slightly varying ages, the members of a brood usually leave the nest more or less together. The three young wrens of nest 6B hopped out of the gourd within the space of five minutes. The following year, the three members of a brood left this gourd during the course of half an hour. Three youngsters flew from nest 26, in a bird-box, during the course of two minutes; and four left nest 34, in the same box, in five minutes. But the departure of four fledglings reared in this box some years earlier was spread over 4 hours and 37 minutes, the first going at 7:43, the second at 8:58, the last two at 12:20. One of these youngsters was under 18 days of age. Nest-leaving is a contagious process; it takes place when the majority of the brood are 18 or, less frequently, 19 days old; and younger members come out with their elder siblings.

There appears to be a rather widespread belief among ornithologists that young birds generally quit the nest in response to the urgings of their elders. Although there are well-documented records of such coaxing, most of them make it clear that the parents were alarmed or made uneasy by apparent danger, often by the presence of the observer. In the absence of all external disturbance, the departure of young from the nest in obedience to parental insistence is certainly exceptional rather than the rule; and some apparently good examples of such behavior are open to alternative explanations, or difficult to interpret. Thus Nice (1948:151) reported that a male Carolina Wren apparently tried to coax the nestlings out of the basket where they were hatched, while the female seemed to try to lead them back into it! According to Perry (1946:141, 178-189), Razorbills (*Alca torda*) and Guillemots (*Uria aalge*) call and coax the older chicks to leave the nest-sites on the cliffs and take to the sea, but their departure seems to be determined chiefly by their own internal state. Although in the absence of external menace parent birds do not often lure their young from the nest, they are more frequently successful in enticing fledglings that have spontaneously departed to move on to a place of greater safety. This, according to Hann (1937:186), is the way of the Ovenbird (*Seiurus aurocapillus*).

While watching from concealment, or at a good distance from the nest and using field glasses, I have witnessed the departure of young birds of a number of species, and

nearly always this has impressed me as being quite spontaneous. Even when parents did seem eager to have later members of a brood follow the first into the open, as with a pair of Inquisitive Tityras (*Tityra inquisitor*), their urgings appeared to have little or no effect upon the movements of the youngsters. There are accounts of parent birds withholding food from their little ones to make them quit the nest, or displaying a morsel in front of them without delivering it, to induce them to come out into the open and receive it. In instances where I have witnessed such conduct by the parents, it has seemed to me to result from the circumstance that a youngster, about to take its spontaneous departure, has occupied the position where the old birds have been in the habit of alighting in order to deliver food. When a young Black-chinned Jacamar (*Galbula melanogenia*) stood in the mouth of its burrow in a bank, the parents, arriving with insects, sometimes fluttered in front without delivering the food, not, I believe, in an attempt to lure the fledgling out, but simply because it rested in the only position where they could conveniently alight and deliver what they held in their bills. Often youngsters that remain in the nest are neglected while members of the brood that have flown receive nearly all the food; but it would be unwarrantable to assert that the parents give less to those in the nest with the intention of forcing them through hunger to quit the nest.

While watching from a distance, often through a window, I have witnessed the undisturbed departure of nine broods of House Wrens, and in every instance they seemed to leave as a result of inner promptings rather than of parental pressure. Often, as the time for their emergence from the nest approaches, the young wrens seem undecided whether to go or stay. A growing restlessness impels them to move from the dimly illuminated nest toward the outer light. They perch in the doorway of the box or gourd, voicing sharp little calls, and may even hop outward along a coarse stick which the parents, when they built, left projecting beyond it. As if fearing a fall, they draw back into the dim security of the familiar chamber, sometimes repeating this again and again before at last they leave. But at times they lean too far outward; strenuous efforts to pull themselves back into the cavity are vain; they lose their hold upon the door sill and flutter earthward.

Often the youngsters fly from the nest immediately after the visit of a parent bringing food, although the adult, so far as can be seen, has done nothing to encourage their departure. As the moment for quitting the nest draws near, a very slight disturbance can upset them and cause them to leave. While I watched a nest containing two well-feathered Guimet Hummingbirds (*Klais guimeti*), the passage close by of a bird so small and harmless as a Pipromorpha (*Pipromorpha oleaginea*) caused a youngster to fly out. With the wrens, the slight excitement attendant upon the presence of the parents, whom they associate with food, sometimes provides the stimulus to flutter from the nest.

How easy it is to misinterpret the actions of the parents while the young are leaving the nest, especially if observation is only casual, was brought home to me while I watched a brood of four House Wrens depart from a nest-box in my garden in 1943. Two of the youngsters had already flown away and two lingered in the box. As usual, the fledglings in the open received the greater share of the parents' attention; and by the middle of the morning the stay-at-homes were becoming hungry and called much. They stood in the doorway, then one climbed out to rest on the end of a projecting twig, which the adults had taken part way into the box. While the youngsters were in these positions, a parent twice brought a morsel of food, perched in front of the box, then carried the food away. After a while a parent returned with an insect and found one fledgling on the end of the projecting twig, but the other had gone back within the box. Brushing past the youngster in the open, the parent took the morsel to the one inside. Thereupon

the first young wren returned into the box, too. Several times more I saw a parent neglect a fledgling in the doorway and give food to the one inside. So long as both were within, the morsel was never carried away undelivered, as when both were in the doorway. During their final days in the hole, young woodpeckers of several species spend much time with their heads in the doorway, but they learn to draw back inside when a parent arrives, thereby facilitating the delivery of food.

A pair of House Wrens which occupied a gourd in an orange tree evinced considerable concern over the exit of their family. The main facts in the departure of a second brood from the gourd, witnessed from the window of my cabin close by, are as follows:

During the morning of the departure of the young, the male sang repeatedly, doing so more frequently than he had sung of late. The female was also excited, fluttering her wings as she approached the nest with food. After leaving, she frequently alighted on a nearby twig to quiver her relaxed wings. She also *churr*ed and rattled a good deal. Sometimes she entered the gourd and remained inside with the nestlings a few minutes, which the male never did. The nestlings were noisy and appeared frequently in the entrance, all three nestling heads occasionally visible in the doorway.

Later in the morning, when all three young were again at the doorway, one at the right side of the doorway tried to leave by climbing out on the side of the gourd. But the smooth, hard, bulging surface afforded no foothold and the young wren then tried to retain its perch on the sill, to which it still clung by one foot. But its stubby tail was already outside the entrance, its position was awkwark, and its two nest-mates pushed from behind. After a few moments of struggle, it fluttered down among the thorny branches of the orange tree and managed to catch a foothold on a branch.

Almost as soon as the first fledgling left the gourd, the second fluttered forth weakly. The third hesitated two or three minutes, then launched forth in the same uncertain manner. Both second and third young also came to rest among spiny branches.

The greatest excitement now prevailed, with parents and young all calling. Both parents flew in and out of the gourd again and again, just as they did more than two months before when the fledglings of the first brood were coaxed to return to their nest for the night. They also entered, several times, a second gourd in the same tree, below the one used as a nest. Up to this time, this larger gourd had been ignored.

Aided largely by the thorns of the branches of the orange tree, the fledglings managed to flit, flutter and scramble up toward their parents, who continued to go in and out of the gourds, especially the one which the young had just left. It appeared for a while as though the old birds would indeed lead the young back to the nest; but just as they came close to it, the parents changed their tactics. Now both male and female parents flew down into low weeds about thirty feet from the orange tree, one singing and the other *churr*ing. They returned to the orange tree and again flew to the weeds, repeating this over and over. One young flew in the direction followed by the parents, and on its first flight covered a measured 50 feet, in a slightly descending course, to alight clinging to the rough trunk of a small guava tree. The other two young promptly followed, but covered somewhat shorter courses of only 33 feet. The young wrens then descended among the weeds, and for the remainder of the day, the family roamed about the weedy pasture.

THE YOUNG WRENS AFTER LEAVING THE NEST

When they leave the nest the young wrens closely resemble their parents in plumage, although if reared late in the season their colors may be brighter than those of the worn feathers of the adults. They are at first readily distinguished from the parents by their shorter bills, yellow corners of the mouth, and persistent tufts of natal down. Immediately upon quitting the nest, most fledglings can fly from ten to twenty yards at a stretch, but slowly and with poor control. During their first days in the open they follow their parents and are fed amid the grass or weeds or dooryard shrubbery.

As evening approaches they are led to a sleeping place by their parents. The lodging selected for the fledglings after their first days afield is usually not far distant from the nest. Sometimes they will be led back to sleep in the nest itself, if this is not infested by

vermin, or not too difficult of access. More often they are sheltered in some neighboring cranny. Four fledglings raised in a hole in a roadside bank in the Guatemalan highlands went to sleep in a niche in the same bank, ninety yards distant from the nest. A brood reared beneath the tiles of a roof—a situation most difficult for unpracticed wings to reach—were taken to sleep in a bird-box attached to the walls of the same house, and much more readily accessible. But they rested here only a few nights; and as soon as they were sufficiently strong, their parents showed them the difficult feat of slipping up under the tiles at the edge of the roof. Successive broods reared in a gourd in an orange tree were sometimes led back to sleep in the gourd itself, once in a hollow banana stump in a yard near by, and again in the thatch of the neighboring cabin. I have even known young fledglings to be taken to roost in the open nests of tanagers and finches, with close-set, sheltering foliage roundabout.

As night approaches, the parent wrens usually come alone to make a preliminary inspection of the sleeping nook before bringing up the young family. The young wrens have a strong inclination to follow their elders, who, when they wish to lead them to a certain point, fly back and forth between their offspring and the destination, until at length the fledglings reach it. The same procedure is used to bring the young wrens to their place of rest, the parents often going in and out, in and out, many times over, the male usually singing the while.

Sometimes the adults select a sleeping nook beyond the skill of the young to attain. Then they continue in the failing light to urge the young to reach the difficult site; but at last, as darkness falls, the adults fly off to their own roosting places, perforce leaving the fledglings in the foliage or the grass. Or at times one member of the brood, weaker than the others, is unable to follow its brothers and sisters to their lodging; it then falls asleep wherever it chances to be. As a rule, those young wrens which pass a night or two exposed to dew or rain suffer no ill effects from the exposure. If the first evening the adult wrens choose a sleeping place that proves impracticable for their fledglings, the next day they may hit upon something easier to reach.

I believe that, even without the example of their parents, House Wrens newly emerged from the nest would instinctively seek shelter at the approach of evening; but doubtless, as with the Red-crowned Woodpecker (*Centurus rubricapillus*) and the Hairy Woodpecker (*Dendrocopos villosus*), a number of nights may pass before they are successful in discovering a suitable lodging. Indeed, the instinct to find a closed place at nightfall develops in House Wrens even in advance of the age at which they normally quit the nest.

One brood of a pair that nested in a gourd beside my cabin was frightened prematurely from the nest by some children, when one was 15, two 16, and the fourth 17 days of age. At the end of their first day in the open, two of the young wrens entered a passageway between the kitchen and the main part of the cabin, and climbed up the rough boards of the wall, all quite spontaneously, it seemed to me. But they failed to reach the roof, or any sheltering cranny. Later, the parents tried to lead them from a point in the yard to the lowest part of the thatch and, this proving inaccessible, then to a conveniently situated low gourd. But the young wrens were by now too tired or drowsy to make much effort to follow. At length, they settled down in a low bush in the yard, pressed close together on their perch. From time to time, as darkness deepened, one youngster would hop upon the back of its neighbor, showing that it was more natural to them to sleep snuggled together than to perch—and at the same time upsetting the other fledgling wren and causing a general reshuffling of the group.

Different broods of House Wrens, even when they emerge from the nest at the normal age of eighteen days, vary considerably in strength and skill in flight; and there is likewise marked diversity in this respect between the members of the same brood. Once they have been led to their sleeping place in the evening, the parents usually but not invari-

ably carry in food to them and remove their droppings. Like fledgling Golden-naped Woodpeckers (*Tripsurus chrysauchen*) and Blue-and-White Swallows (*Pygochelidon cyanoleuca*), after being taken to roost they are treated exactly as though they were nestlings that had never used their wings. Finally, as the light wanes, the female may come to join the young for the night. On this point, female House Wrens differ; and even the same individual may vary her procedure with different broods. If the fledglings have been led back to the nest or taken to some well-sheltered nook, she is more likely to sleep with them than when perforce they spend the night in a more exposed situation. In the morning, the young wrens linger in their shelter for about half an hour after the adults become active; and their first food is brought to them there. As the days pass and the young birds grow stronger, their time for retiring in the evening and becoming active in the morning gradually approaches that of the adults.

The period over which young House Wrens receive attention from their parents and are allowed to reside in the parental territory varies greatly from brood to brood; but at best the tie between old and young is never so lasting as with Golden-naped Woodpeckers and Banded Cactus Wrens (*Campylorhynchus zonatus*). Some House Wrens find part of their own food after they have been out of the nest only ten days and are not more than four weeks old. Others, especially the last brood of the season, may receive some food from their parents until nearly two months of age.

The three localities where I followed for the longest periods the behavior of young wrens after leaving the nest are as follows: above Tecpán in the highlands of west-central Guatemala, at an altitude of about 8500 feet; Rivas in the valley of El General in Costa Rica, at about 3000 feet; and Quizarrá in the same valley at about 2500 feet, about ten miles from Rivas. My observations at Tecpán covered a period of about eight months, from May to December, 1933; at Rivas, one and a half years in 1936 and 1937; at Quizarrá, the decade from 1942 to 1952, although not with equal thoroughness throughout this long period. After the foregoing general statement, based upon observations made at several localities in Central America in addition to those just mentioned, I shall describe briefly the variant behavior of these three groups of House Wrens.

In the high mountains of Guatemala, the House Wrens appeared to raise only a single brood, in April and May, when the great majority of birds of other kinds nested. One pair, indeed, began a second nest in June, as though to produce another brood; but although the female slept on the nest, she laid no more eggs. It was interesting to follow the gradual dispersal of the single brood of young wrens, without the complicating influence of subsequent broods. Their mode of sleeping, in niches in the roadside bank where they were easy to find, greatly facilitated the study. On the last day of May, four days after their departure from the nest in a burrow, I found the four fledglings sleeping in a shallow niche in the earthen bank, about 90 yards from the similar but deeper cavity in which they were reared. The female parent did not pass the night with them; apparently there was not room for her in the cranny, which was barely big enough to accommodate the four closely packed fledglings. Two nights later, the wrens lodged in a neighboring niche, 50 feet away. This was screened by vegetation drooping from the top of the bank, and also it was more capacious. I believe that five wrens—the female and her four fledglings—were cuddled together here; but to count them with accuracy was difficult.

But when they had been out of the nest for only nine days, the young wrens began to lodge apart. Three slept in one cranny in the bank, the other with a parent in a neighboring niche. Thirteen days after their departure from the nest, two fledglings slept together, one alone; the fourth had vanished; and the female slept on the new nest she never quite completed. But at the end of June, when they had been a month in the open,

I again found three wrens sleeping together, in the entrance to a burrow that a pair of Blue-throated Green Motmots (*Aspatha gularis*) were digging. The motmots had chosen as their starting point one of the niches where the wrens lodged. As soon as they completed their subterranean chamber and began to occupy it by night, they scattered the little brown wrens, who retired earlier and arose later than their bigger neighbors.

After this, I found the wrens sleeping always in solitude. By the end of July, two months after the departure of the young from the nest, four, including both parents and offspring, slept in as many niches spread out along 50 yards of roadway. I was no longer able to distinguish the adults from the young. Four wrens, apparently always the same individuals, continued to take shelter in the same stretch of bank where the nest had been, but not always in the same niches, until the end of the following November. But at the time of my last visit in mid-December, I could find only three. Although each member of the family lodged alone after the young had been out of the nest a little over a month, the latter remained in the parental home-area for at least half a year longer.

At Rivas in 1936, three young wrens of the first brood, hatched in April, were taken by their parents to sleep in the gourd where they grew up. Here they continued to roost beside the female while she incubated her second set of eggs. After the nestlings of the second brood were born, these full-grown older brothers and sisters were refused admittance by the female when they came to join her in the evening. The young wrens were persistent in their attempts to enter, and the male assisted in driving them away from the entrance. After their expulsion, he slept in the gourd with his mate and the nestlings. This is the only instance I have known of a male House Wren's sleeping in the nest with his mate, although the male of another pair tried to join his partner at nightfall but was repulsed by her. After their eviction from the gourd, the young wrens, now over two months old, promptly vanished from the vicinity. After the fledglings of the second brood left the gourd, they were taken to sleep in an old banana stump and other provisional quarters for a few nights, until they were strong enough to fly up and roost in the thatch of my roof. The young of the third brood were likewise led to sleep amid the sugar-cane leaves of the thatch.

The following year, 1937, the same pair of House Wrens nested in the same gourd and, after trying half-heartedly to evict the young of the first brood from the gourd, permitted them to sleep in it while the nestlings of the second brood were growing up. The two surviving wrens of the first brood then began to feed the one surviving nestling of the second brood. This unusual situation led to complications which are related in detail in the following section.

Until 1943, I had seen House Wrens lead their fledglings to sleep only in snug crannies where they were sheltered from the rain; or if at the end of their first day in the open the youngsters were not strong enough to reach an adequate shelter, they were allowed to sleep in an exposed position only until they could fly to a better one. But the House Wrens which nested beneath the newly laid tiles of my roof at Quizarrá in 1941, and each succeeding year have reared their broods either in this roof or in a bird-box that I provided for them in the garden, have behaved in a manner which invalidates some of my earlier generalizations.

In front of the house, at the edge of the high terrace on which it stands, is a row of calabash trees (*Crescentia cujete*) whose leathery foliage is borne in close clusters along the thicker branches as well as the terminal twigs. Amid this sheltering foliage, tanagers of three or four kinds and the Variable Seedeater (*Sporophila aurita*) each year built their open, cup-like nests. In August, 1943, one of the fledgling wrens of the third brood, who had emerged from beneath the tiles only two days earlier, was found sleeping in the abandoned nest of a Blue Tanager (*Thraupis episcopus*) in the calabash tree

with the fullest and most leafy crown. I believe that other members of the brood may have been led to rest in other open nests higher in the tree, where they could not be seen in the dense foliage. The young wren occupied the tanager's nest only a few nights, then moved to undiscovered quarters.

When the fourth brood of wrens left the bird-box in the middle of September, 1943, they were at first taken to sleep beneath the tiles of my roof; but for reasons unknown to me they did not continue to lodge here. A few nights later I found that at least two were roosting in an open nest built by a Song Tanager (*Ramphocelus passerinii*) in the top of the calabash tree, well screened by the foliage. A little later they shifted to what remained of a tiny nest of a Variable Seedeater, a structure originally slight, and now so dilapidated that it hardly deserved the name of nest. But the leaves clustered thickly about it afforded the young wrens some protection from the wind, if not from the rains which at this season fell almost every night. One of these wrens continued to make this frail remnant of a nest its nightly lodging for more than two months, or until early December. Then it changed to the well-weathered remains of the open nest built five months earlier in the crotch of a neighboring calabash tree by a pair of Golden-masked Tanagers (*Tangara nigro-cincta*). Here it was in an exposed position and partly visible from the ground as it slept. Each evening, as it went to roost, it would approach in silence, then voice a few slight, nervous-sounding notes when about to enter the nest. Sometimes, instead of in the tanager's nest, the wren slept in a crotch a foot higher, where it lacked even the vestige of a nest but enjoyed better concealment by the foliage. The bird continued to roost in the old tanager's nest until about the beginning of February, when it vanished from the vicinity, probably having been driven off by the parents as they prepared for the new season's nesting operations. This House Wren had followed, until at least five months of age, an unusual habit of sleeping formed, apparently under parental guidance, as a fledgling newly emerged from the nest.

The following April these same parents led their three newly emerged fledglings to sleep amid clusters of foliage at the very top of one of the calabash trees, at least 20 feet above the edge of a high bank that falls away to pastureland below. To my knowledge, there had never been a nest of any kind in this spot, and the sleeping fledglings were not wholly invisible from the ground. On subsequent evenings they made trial of neighboring leafy bowers, finally settling on a crotch between four thick, mossy boughs, well screened by foliage. Here two of them continued to lodge for at least a month, finally vanishing in May, while the female was incubating her second set of eggs in a bird-box.

The second and third broods of 1944 were treated like the first, the fledglings being taken to sleep in the calabash trees where they were exposed to the rain. Here some of the youngsters continued to roost during the worst of the wet season; these open crotches were occupied by two wrens until the following January and by one, probably the female parent, until nesting was resumed toward the end of February, 1945. In this year, too, these wrens adhered to the tradition of allowing their young to sleep in exposed places. The fledglings of the first brood were, it is true, taken to sleep in the nest-box after their first day in the open. But the box had been invaded by a colony of big, black, carrion-eating ants, and the young did not again return to it. Instead, they slept in a hillside pasture behind the house, creeping into fissures and crannies of the rotting stumps where they were not well shielded from the rain. After a few nights here, they went to roost in the calabash trees where five broods of their predecessors had slept during the two preceding years. The second brood of 1945 was a failure. Two fledglings of the third brood, reared beneath the tiles at the back of the house, at the end of their first day afield, went to roost on an exposed branch at the very top of a neighboring guava tree. Here they slept, pressed close together, through a rainy night.

In subsequent years, the pair of wrens about my house have varied their procedure, sometimes taking their fledglings to sleep in an open nest amid the foliage, sometimes into a bird-box or a snug cranny that provided shelter from the rain.

Although adult House Wrens often possess dry shelters, I have never known one to retire to its dormitory by day in order to avoid a wetting. Young wrens sometimes do so, at least if a rain falls late in the afternoon. When a shower started at about 5:15 on May 21, 1937, three 27-day old wrens, which had been hopping about in the vicinity of the gourd where they slept, went into this shelter and stayed until the rain stopped. Then they came out and did not retire for the night until considerably later. Two days after this, a shower at five o'clock drove only one of the youngsters to the sheltering gourd. Since none of its comrades followed, it promptly came out and took a wetting in company in preference to dryness in solitude!

YOUNG HELPERS

In describing the sleeping arrangements of young wrens, I mentioned the fact that when permitted to roost in the nest-cavity where the nestlings of the succeeding brood were growing up, they helped to attend these younger brothers and sisters. Such helpfulness by juvenal House Wrens is so closely associated with their manner of sleeping that the two subjects can be treated separately only at the expense of some repetition. Although with a few birds, as Banded Cactus Wrens and White-tipped Brown Jays (*Psilorhinus mexicanus*), nests appear to be regularly attended by juvenal or unmated helpers (Skutch, 1935), this situation is unusual among House Wrens. I have found it in only one family of the many that I have watched; but here it was of regular occurrence during one nesting season, when the young of two consecutive broods helped in turn to feed the nestlings of the subsequent broods. This helpfulness appeared to be dependent upon the close association between the young of two broods when they slept in the same nest-cavity. In only this single family have I known older young to roost in the nest-box or gourd for more than a few days after the subsequent brood hatched, and only in this family did I discover juvenal helpers.

This was the family of wrens which for two seasons nested in the gourd that I had placed in the orange tree beside my thatched cabin at Rivas in the valley of El General. In 1936, the three fledglings of the first brood were led by their parents to sleep in the gourd where they had been hatched. They continued this custom while the parents renovated the nest and during the whole period of hatching out the second set of eggs. But as the youngsters grew older their parents became increasingly opposed to their sleeping in the gourd, and this growing antagonism resulted in their eviction from it and disappearance from its vicinity durng the ten days after the hatching of the second brood.

In 1936 this pair of wrens did not begin to breed, so far as I know, until late March, when the great majority of small passerine birds in the region were also preparing to nest. But after molting in October and November, this pair resumed nesting at an exceptionally early date, laying the first egg of a new breeding season on December 27. Their offspring of the present season seemed more precocious than the broods reared by the same parents in the preceding year. They were stronger in flight and seemed more self-reliant, uttering fewer calls than the fledgling of the earlier broods at the same age. Because of their greater precocity, which made them better able to resist the parents' efforts to evict them from the gourd, and also, it seemed to me, because of greater indulgence by the parents themselves, one of these young wrens succeeded in remaining with the nestlings of the second brood during the whole of their period in the nest.

Two of the four eggs of this second brood vanished mysteriously during the period of incubation. The other two hatched on March 13, 16 days after the last of the nest was laid. When I watched the family retire on the evening of March 15, I judged from the hesitant approach of one of the young, and its sudden retreats, that the female, already brooding inside the gourd, was opposing its entry. Later, however, all three young wrens of the first brood went into the gourd for the night. Soon

after this one of this trio vanished. I believe that this was the one which for some days had been in the habit of remaining away from the gourd until after the male parent had gone to roost in the thatched roof of the cabin, although the other two young had already entered the gourd while he still sang close by it. This could have been the young male who had already, at the age of 46 days, given his first warbling juvenal song and was thereafter looked upon by his father as a rival.

Of the two youngsters who continued to sleep in the gourd, one had the lower mandible extensively yellowish or horn-color, as in the adult male; the other's bill was almost wholly black, as in the adult female. Hence I inferred that the first (Y) was a young male, the second (B), a young female. My belief that the black-billed youngster was a female was confirmed when later she voiced the typical weak song of the female wren. The young could still be distinguished in a good light from the parent of the same sex by the lingering yellow at the corners of their mouths and at other times by the immature notes they often voiced.

While the parents fed the newly hatched nestlings of the second brood, Y and B would from time to time visit the gourd during the day. If the parents coming with food caught them there, they tried to chase these self-supporting offspring away. However, the parents' opposition to these visits, especially that of the female parent, was on the whole relatively weak. Once I saw the male knock one of the youngsters to the ground. But after March 24, when I first saw a young wren of the first brood bring food to the one remaining nestling in the gourd, parental antagonism to their presence all but ceased. I am not certain how two eggs and one nestling had vanished from this well-enclosed nest, but surmise that the scuffles attending the attempted exclusion of the older youngsters were somehow responsible for their loss.

When I first saw a young wren take food into the gourd, on the afternoon of March 24, it was 69 days old. It lingered within for 23 minutes, during which the male thrice passed food to it through the doorway, the female once. Presumably the food was delivered by the young wren to the nestling. During 12 of these minutes the female was in the gourd with the young wren. The following day I saw the female peck at a young bird when, without bringing food, it tried to enter the gourd with her. But later the female and a youngster spent 16 minutes together in the gourd with a nestling.

On the morning of March 26, I watched for two and a half hours, during which the male took food to the single nestling 15 times, the female 9 times, and B 7 times—31 feedings in all. Y came twice to the gourd and each time lingered within for several minutes, once in company with B. Much of the food brought by the male and some of that brought by the female was passed to B for delivery to the nestling. With gaping mouth and quivering wings, she begged for the food like a hungry fledgling. Once, too, I saw her, again with vibrating wings, yield food to the female at the doorway. But when B, resting in the entrance of the gourd, begged for food from Y as she arrived, she refused to relinquish it, pushing past him into the chamber, where together the two remained for a minute.

With only one nestling, already nearly fledged, and two young assistants to help attend it, the parent wrens were far from fully occupied. In a guava tree about 60 feet from the orange tree that held their old nest was a smaller gourd chosen by the wrens for their next nest. Early in the morning of March 28 they went together to the guava tree and sang exuberantly, the male repeating again and again while his partner accompanied him with her simple *twitt*ing refrain ending in a musical little trill. Then the two set about to fill the new gourd with light twiglets picked up from the ground. At intervals they interrupted this activity long enough to take food to the nestling in the old gourd. With two nests in different stages simultaneously claiming their attention, it is not surprising that occasionally they brought an insect to the new gourd where only twigs were wanted, or offered a billful of twigs to the hungry nestling. This inedible material was usually deposited with the young who could not swallow it, but occasionally the parents discovered their error in time and carried it across to the new nest.

B, who early in the morning had been feeding the nestling quietly enough, began at about seven o'clock to behave queerly. Advancing to a small tree midway between the two gourds, she voiced a sharp, rapid *twitt*ing, much like the "song" of some adult female House Wrens, but a performance weaker than that of an adult. Thence she proceeded to the guava tree and tried to enter the gourd where her parents had just begun their new nest, while the adult female strove to drive her away. The excitement now became intense; the birds flitted around so rapidly that it was scarcely possible

to recognize them individually. B, perching in one spot in the guava tree, for a long time quivered her relaxed wings and twitted. The female flitted nervously about and threw up her wings with a rapid, twitching motion, while the male sang loudly and incessantly.

Soon after this preliminary bout the wrens took food to the nestling. B delivered food to the female parent, which had just brought food to the old gourd and remained to move sticks that she and her mate had carried in by mistake. But when the parents resumed work on the new nest, B again followed and started to enter the new gourd. Thereupon the adult female clinched with her, and the two tumbled to the ground. Thus began the longest and fiercest series of battles that I have ever witnessed among birds of any kind. The young female was clearly the aggressor. The adult female did not oppose B's attendance to the nestling in the old gourd but fought her intrusion into the new one. Yet B persisted in visiting the new gourd. At first the old gourd with the nestling was regarded as neutral territory; but before long B tried to keep the adult female out when the latter arrived with food; and when the adult female forced her way in, another fight began. The quarrelsome young wren even pecked savagely at Y as he came to the doorway without food; but Y withdrew tamely after two such rebuffs.

There was no actual skirmishing between B and the adult male, but when, in the absence of the female, B entered the new gourd, the male continued to dart at the doorway until she left. Between the adult female and B there were numerous severe struggles through a long day. Often the two grappled in a gourd for short periods, then rolled out and fell to the ground clutching each other. The male never entered a gourd where a battle was raging, but stood singing near the doorway and prevented Y from going in. The older female was clearly the stronger. In one unusually violent bout, the two tumbled about on the ground, then for a long while lay gripped together, scarcely moving, until one cried out. The adult female at last flew off without difficulty. B could only flutter up to a low weed stalk, where she hung upside down by one foot, the other, temporarily disabled, clutching helplessly at the empty air. Half her tail feathers were missing, and there was blood on her chin. But after a minute she could perch upright once more, and before five had passed she was again pursuing her parents, quivering her wings and *twitt*ing.

After these encounters, the female, showing no signs of battle or fatigue, would come to the gourd in the orange tree, look in, hear the calls of the nestling, then go off and in a minute or so return with food. The male, as the morning advanced, gave less attention to carrying sticks into the gourd and more to the nestling. Y, also, now began to bring food frequently. His specialty was long green larvae, while the others brought chiefly cockroaches captured in the thatch of my roof. As time passed, the female and B (its daughter) seemed to tire and fought less vigorously.

During the afternoon, all four of the grown wrens brought much food to the nestling. The female drowsed in the orange tree, closing her eyes for a few seconds at a time; while B, sitting in the doorway of the gourd only a few feet away, rested in similar fashion. Yet until evening B persisted in following the female about, *twitt*ing and quivering her wings, to which the older wren usually reacted by moving away.

That evening the female and Y retired early into the gourd with the nestling. B later joined her mother and brother (Y) in the gourd. The male delivered a final song in the twilight, then went to sleep in my roof.

Next morning B went off by herself and was absent most of the day. The male, completely occupied by singing and filling the new gourd, seemed to forget about the nestling. He built alone most of the time; for, with her most active helper gone, the female had to give more attention to the nestling. But Y assisted her, both in bringing food and cleaning the nest. When I went to look into the gourd, Y scolded with a harsh, sharp *churr*ing and dared to come closer to me than the female parent. In order to see what he would do, I put my hand over the doorway of the nest, whereupon he flitted wildly among the branches of the orange tree, scolding loudly, and approaching to within a yard of my hand. That night he alone took charge of the nestling, while the female slept in the new gourd and the male in the roof. Next morning the female again made the mistake of putting a sheaf of indigestible building material into the nestling's gaping mouth!

Early in the morning of March 31, the single nestling left the gourd, eighteen days after hatching. Since its lower mandible was wholly yellowish, I inferred that it was a male—a supposition later confirmed when I heard it singing. To distinguish it from its elder brother, I will refer to it as M.

Both of these young males, representing two broods, slept with their mother in the new gourd that night. The parents had now taken into this gourd all the sticks it could hold and were lining the hollow they had left at the rear to receive the eggs. Only six days after M left the old gourd, the first of another set of four eggs was laid in the new gourd. Before this happened, Y disappeared, leaving only M to sleep in the gourd while the female incubated this third set of eggs. Nest-building over, the male now attended the youngster (M) while the female incubated.

This time all four eggs hatched and all four young were fledged. M slept with them on most nights until they left the gourd. M also fed them, but not so frequently as their parents. During a sample period of two hours on the morning when the four nestlings were 13 days old, the male brought food 21 times, the female 18 times, and M (54 days old) 5 times. It was easy to distinguish him from the male, not only by the persisting yellow corners of his mouth, but by his manner of approaching the gourd. Both parents would fly up to the doorway from the front in a direct, efficient manner; but M usually first alighted in the lower part of the orange tree and advanced toward the gourd in a circuitous course, sometimes passing behind it, then doubling around to the entrance. As he flitted from twig to twig he betrayed his immaturity by voicing a few low *tics* or *tucs* or a little *churr,* just as the helpers of the first brood used to do when they came to feed a nestling. After delivering what he had brought to the young, M would often linger close by in order to beg with quivering wings for the food the parents brought. Sometimes his pleading was rewarded, and then he would pass the food to one of the nestlings. M was always eager to remove their droppings. Once when one was delivered to the female, M seized an end of the white pellet in his bill and pulled until part of it broke away. Then each of the two carried off a part. Sometimes M would carelessly drop a fecal pellet, which would lodge on a leaf below the doorway and later would be removed by the female.

A few days after the young of the third brood were driven prematurely from the nest by some children, M died while sleeping beside one of the fledglings in a gourd. I could discover no cause for his sudden death. I did not remain at Rivas long enough to learn whether the young wrens of the third brood would carry on the family tradition by helping to attend those of the fourth, which the female was hatching in the gourd when I left in June.

Four years later I returned to El General and built a house on my own land, which even before completion was claimed as a residence by the usual pair of House Wrens. But because these wrens, as already related, so often trained their fledglings to sleep in open nests of other birds rather than in their own nest-box, they lacked the close association with the nestlings of subsequent broods which seems necessary to induce them to feed these younger brothers and sisters. In 1947, however, a brood of fledglings was led to sleep in the nest-box just outside the dining-room window. After the female began to incubate her next set of eggs in this same box, the male repeatedly tried to drive the young off when they came to enter in the evening, but without success. Once the female pecked at one young as it came out of the doorway in the morning. Despite these rebuffs, one young wren of the first brood still slept in the nest-box when the eggs of the second brood hatched. Two days later the nestlings vanished mysteriously.

Alfaro (1927:369) tells of a young House Wren which "under parental compulsion" helped to bring material to a new nest its parents were building in a box attached to a wall in his laboratory. No similar instance has come to my attention with wrens, although juvenal European Barn Swallows (*Hirundo rustica*) and other birds have been known to assist in nest-building (Nice, 1943:79).

FIRST SONGS OF YOUNG MALES

I have heard the first essays of song by a young male House Wren when it was only 34 days old. Although capable of finding a good deal of food for itself, it still followed the male parent, begging for additional nourishment. Another young wren was first heard to sing when 46 days old; its weak song was practiced while the male parent sang nearby. When this young wren flew he was closely pursued by the father. A young wren in another locality, one of a late brood hatched on August 30 was first heard singing

at the end of October, when two months old. This juvenile sang for a long while, giving low warble. The adult male was in the shrubbery in the yard and delivered scolding notes toward this juvenile. Soon both vanished.

The earliest song of the juvenal House Wren is an indefinite sequence of low notes with no set phrasing, often hardly more than a whisper song, and wholly different from the short, clear, sharp, structurally complex verses of the adult male. A similar contrast between the low, diffuse, vague song of the beginner and the short, loud, sharply stereotyped phrases of the adults is found in the Chinchirigüí Wren (*Thryothorus modestus*) and the Riverside Bay Wren (*T. nigricapillus*), as well as in finches and other birds.

NUMBER OF BROODS

We can now consider, in more detail than previously, the length of the breeding season of particular pairs, the interval between successive broods, and the number of broods undertaken in a year. My information on this subject is derived almost wholly from two groups of birds: the pair which in 1936 and 1937 nested in a gourd in an orange tree beside my cabin at Rivas; and the pair or pairs which for the last decade have nested at times beneath the tiles of the roof of my present residence at Quizarrá in the same valley, at other times in a bird-box provided for them in the garden (see table 1).

In 1936, the pair that nested in the gourd successfully reared three broods between April 1, the approximate date of laying the first egg of the first brood, and September 11, the date of the departure of the two fledglings of the third brood. These young received food from their parents until mid-October. Then, on December 27 of the same year, the female wren, after a rest from family cares of less than three months, laid the first egg of what I consider to be the first brood of a new breeding season. When I left this locality in mid-June of 1937, the wren was incubating her fourth set of four eggs for this season, having laid 16 eggs and successfully raised at least one fledgling in each of the three earlier broods. If she continued to breed as long in 1937 as she did in 1936, when she began to nest much later, she could have reared or attempted to rear five broods that year.

My information about the wrens at my present house contains certain gaps, because sometimes they build beneath the tiles of the roof where it is not feasible to visit the nest. However, even when the nest was inaccessible, I could calculate the approximate date of laying from the known date when the young emerged from beneath the roof. Table 1 gives a summary of the breeding activities of the wrens about my house for six years from 1943 to 1949, with the exception of 1946.

It will be noted in the table that in 1948 six broods were attempted, although only one was successfully fledged. This is the greatest number of nesting attempts by any single pair of House Wrens in one year that has come to my notice. In 1943, in a nesting season extending from the end of January, when building began, to September, four broods were fledged; but the exact number of young that left these four nests is not known, because some grew up beneath the tiles where they could not be counted. This is the greatest number of successful broods that I have recorded. In some years, as 1944 and 1949, only three broods were attempted. When the wrens use the same nest for a later brood, they throw out the old lining of feathers and add a new one.

The last column in table 1 gives the intervals in days between the departure of the fledglings of one brood and the beginning of laying for the subsequent brood. These intervals between broods ranged from 6 to 66 days. The last is so long that I suspect that the pair may have tried, unsuccessfullly, to rear another brood, in some nook which escaped me, in the interval between the two recorded nestings. The exceptional circum-

stances attending the laying of the first of a new set of eggs only six days after the departure of the nestling of the preceding brood are recounted in some detail above in the section on "Young Helpers." Leaving aside these extremes, but including a 28-day interval that I recorded in another part of El General, 15 intervals between the emergence of one set of fledglings and the resumption of laying ranged from 14 to 36 days, with

Table 1

Summary of Nesting Records of House Wrens at Rivas (1936, 1937) and Quizarrá (1943–1949) in the Valley of El General, Costa Rica

Year	First egg laid	Size of set	Young left nest	Number fledged	Interval between broods
1936	*ca.* Apr. 1	?	*ca.* May 6	3	
	ca. June 9	3	July 14	3	*ca.* 34 days
	Aug. 6	4	*ca.* Sept. 11	2	23
1937	Dec. 27 ('36)	4	Feb. 1	3	
	Feb. 22	4	Mar. 31	1	21
	Apr. 6	4	May 10	4	6
	June 6	4			27
1943	*ca.* Feb. 6	?	Mar. 14	3	
	ca. Apr. 19	?	May 25	?	*ca.* 36
	ca. June 24	?	July 30	?	*ca.* 30
	Aug. 13	4	Sept. 17	4	14
1944	*ca.* Mar. 8	?	Apr. 13	2	
	May 10	3	June 14	2	27
	July 8	4	Aug. 12	4	24
1945	Mar. 6	4	Apr. 11	4	
	June 16	3	(lost)		?66
	ca. July 13	?	Aug. 18	3	
1947	Feb. 28	3	Apr. 5	3	
	Apr. 21	4	(lost May 11; aged 2 days)		16
	May 21	4	June 24	2	10*
	July 10	4	Aug. 14	3	16
1948	Mar. 6	3	(Eggs deserted by Mar. 11)		
	Mar. 26	3	(Eggs lost by Mar. 30)		15*
	Apr. 16	4	(Killed by ants)		17*
	May ?	?	(Lost in June)		
	July 9	5	Aug. 15	4	
	ca. Sept. 14	2	(Eggs lost Sept. 16)		*ca.* 30
1949	Mar. 23	4	Apr. 29	4	
	ca. May 24	4	*ca.* June 30	4	*ca.* 25
	ca. July 17	5	Aug. 20	?	*ca.* 17

* Interval between the loss of eggs or nestlings and laying the first egg of the next brood.

an average of 24.5 days. Those figures in the last column of table 1 that are marked with an asterisk are not intervals between successful broods, but between the loss of eggs or nestlings and the laying of the first egg of a new set. In one instance when newly hatched young disappeared from the nest, a new set of eggs was begun ten days later. In two cases when the eggs were lost a few days after laying, the first egg of the replacement set appeared 15 and 17 days later.

Only in the single instance of the pair which began to build a new nest while their older children helped to feed the one surviving fledgling have I known the Southern

House Wren to begin preparations for a new brood before the nestlings of the previous brood had taken wing. But with the North American House Wren, Kendeigh (1941:46) found six examples of this behavior, which he calls "multiple nesting," out of the great number of nests which he studied. The female of this species may even begin to lay again before she has finished caring for the first brood. At times the female North American House Wren actually abandons her first brood to start a second brood the sooner, but such desertion does not ordinarily occur without provocation. When the female neglects them, the male will as a rule take care of the young, but although he feeds them he does not brood or stay with them during the night. Sometimes the female's second nesting is in the territory of another male. With the non-migratory Southern House Wren, the bond between the sexes is stronger than with the migratory North American House Wren, and the male of my pair shared his mate's interest in both the new and the old nests.

Although I, myself, have never observed another instance of parent birds of any species preparing for a subsequent brood before the young of the earlier brood had left the nest, this practice, apparently uncommon, is by no means confined to wrens. Thomas (1946:159) records an instance of a Bluebird (*Sialia sialis*) which started to build a new nest two days before the one surviving nestling of the first brood had left the nest-box. With Cedar Waxwings (*Bombycilla cedrorum*) Putnam (1949:172) found that the pair commonly built their second nest while still attending their first brood, and that the female began to lay again in the interval extending from the day before the first brood was fledged to three days after, the male meanwhile feeding these earlier young. One Great Tit (*Parus major*) laid the first egg of her second set a full 24 hours before her first brood flew from the nest; and three other female tits resumed laying the day the first brood left the nest-box, presumably an hour or two before this event (Gibb, 1950:516). A female Ruby-throated Hummingbird (*Archilochus colubris*), which receives no assistance from a mate, built a second nest while attending her first, and incubated two eggs while she cared for the single nestling of the earlier brood (Nickell, 1948:242). Similar multiple nesting has been repeatedly observed in the related Black-chinned Hummingbird (*A. alexandri*) by Cogswell (1949:176-178). I watched a female White-eared Hummingbird (*Hylocharis leucotis*) feed a well-grown fledging of the previous brood in the intervals of warming her second set of eggs, but so far as I know she did not begin to build this second nest until this young had flown from the first nest. All the foregoing examples refer to nidicolous birds; but among nidifugous species an overlapping of broods fully comparable to any of the preceding cases was observed by Gross (1949:43), while studying the Antillean Grebe (*Colymbus dominicus*) in Cuba. While incubating their fifth set of eggs, the parents fed four young of the preceding brood, only three weeks old, and even found time to give a few morsels to youngsters of the second and third broods.

The great fecundity of the Southern House Wren, far exceeding that of any other passerine bird of Central America for which I have information, helps us to understand its great range and explains why, in a region where a rapidly expanding human population is constantly destroying the forest to make room for agriculture, there are always wrens to take possession of each new clearing and establish a territory at each new dwelling.

NESTING SUCCESS AND CAUSES OF LOSS

I know the history of 26 nests found before the eggs hatched—in all but a few cases before the set was complete. All but three of these nests were situated in the valley of El General. These nests contained a total of 90 eggs, of which 68 (76%) hatched, and

from which 51 (57%) young were fledged. Seventeen of the 26 nests produced at least one living fledgling. This overall nesting efficiency of 57 per cent may be compared with the success of 14 species of hole-nesting passerine birds in the Northern Hemisphere tabulated by Allen and Nice (1952:640). Results compiled from 32 separate studies of these 14 species show an efficiency of 66.2 per cent. Although this is better than the record of my House Wrens, some of the individual studies show nesting success to be far lower than these wrens'. Four separate studies of the North American House Wren, summarized in Nice's table (*loc. cit.*), show that nesting success ranged from 48.3 to 83.7 per cent. My own numerical result is based upon too few nests to be of much significance, but I give it because of the paucity of information of this sort recorded for tropical birds.

Six of the 90 eggs, although remaining in the nest, failed to hatch. One of these contained a dead embryo, and others were apparently infertile. The only other known cause of losses of eggs and nestlings was ants. In three cases ants were definitely responsible for the destruction or desertion of nests, and in several additional instances they fell strongly under suspicion. Ants of a number of kinds establish their colonies in crevices in trees such as wrens use for sleeping and breeding, and even in bird-boxes and crannies about human dwellings. Some are carnivorous and destroy young birds. However, the discovery of dead nestlings being devoured by ants is not proof that these insects killed them. The ants might have begun to consume them after they died from other causes. Thus, the nestlings in a hollow stump, open to the sky in an unshaded field, might have died from excessive heat or drowned during a rainstorm, then have been found by the ants during the several days that elapsed between my visits. But ants of a variety of kinds are certainly one of the major enemies of nesting birds in the tropics, and they not infrequently attack nestlings at higher latitudes.

A bird which makes its nests in saddle-bags, bunches of bananas, and other objects of human use, must frequently be dispossessed when these things are needed by their owners. A friend of mine managed to get along without his saddle-bags until the young wrens in them were fledged; but not everybody is so considerate of birds. Domestic chickens sometimes catch weakly flying fledglings that have fluttered to the ground on emerging from the nest. Since the wrens so often nest in dooryards where poultry roam, this must be a not infrequent cause of loss. I personally have witnessed two instances of this. In some parts of its range, at least, House Wrens are subject to parasitism by cowbirds, as reported by Haverschmidt (1952:295) and others.

COMPARISONS WITH OTHER WRENS

It may be profitable briefly to compare the life history of the Southern House Wren with that of other wrens, particularly with its congeners in the genus *Troglodytes*, as known to us from the published accounts of Kendeigh (1941), Bent (1948), Armstrong (1952) and others. With the North American House Wren, Kendeigh (1941:47) found that about six per cent of the matings were polygynous, and with some populations of the European Wren the incidence of polygyny may approach 50 per cent, but no instance of a plurality of mates was noticed in my studies of the Southern House Wren. While it is true that the number of pairs that I observed with any care is small, the male's constant participation in nest-building and large share in feeding the young at all stages indicates a pattern of activities incompatible with polygamy. In remaining in pairs throughout the year, the Southern House Wren behaves in the fashion which appears to be typical of the non-migratory species of this predominantly Neotropical family (Skutch, 1940), but has perforce been modified by the few species of wrens which, as a consequence of extending their range far into the north, became wanderers or migrants during the cold winter months.

Among these far-northern species of *Troglodytes,* in both *T. troglodytes* and *T. aëdon,* the male starts or even finishes the foundation or shell of the nest before the female arrives on his territory. The presence of the coarser constituents of the nest in a suitable site is his invitation to potential partners. After inspecting the available nest-site, the female proceeds to line and finish the nest by herself. But pairs of Southern House Wrens, which have in many instances been long associated on their territory, build together from the start. The male may indeed be somewhat more active in bringing the first sticks, but in other instances it is the female; and always I have found that both participate in this preliminary part of nest construction. But in leaving to his mate the greater part of the task of lining, particularly the innermost lining of downy feathers, while he in some cases continues to fetch superfluous sticks, the male Southern House Wren shows an approach to the condition exemplified by his northern congeners.

The Southern House Wren is more prolific than many species of Central American wrens; yet even within the tropics its usual set of four eggs is equalled or exceeded by the sets of other genera, notably the wrens of the genus *Campylorhynchus.* As with other wide-ranging species, the clutch size of the Southern House Wren increases with latitude, until beyond the tropics, in Argentina, it may produce sets of nine eggs, a number which compares favorably with those known for the North American House Wren and the European Wren.

Like its northern congeners, the Southern House Wren guards a territory from which it zealously excludes rivals of its own species, and from which as a rule it drives its offspring after they can take care of themselves. I have never known two pairs to nest in or about the same house, or even in two buildings separated by as much as fifty yards, although crannies suitable for a number of their nests were not lacking. In the districts where my studies were chiefly made, pairs were so widely scattered that I could learn little about the extent of the territory claimed by each. I have seen little of territorial disputes between adults. Among tropical birds resident in the same area throughout the year, the acquisition of territories is effected with far less visible friction than among migratory species which must claim their home site and settle differences with neighbors in the course of a few weeks. Hence I directed my attention to the relations within the family rather than to those between neighboring families.

Both the incubation and nestling periods of the Southern House Wren are substantially longer than those of its North American counterpart, being normally 15 and 18 days, respectively, for the former, but only 13 and 15 for the latter. Thus the interval between the beginning of incubation and the departure of the young from the nest is typically 33 days for the Southern House Wren and 28 days for the North American House Wren. The difference of five days in favor of the northern species more than offsets the two to four additional days required to lay its larger sets of six to eight eggs; so that although the northern bird rears the bigger family, it does so in a shorter period. A similar acceleration in the rate of development of embryos and nestlings at higher latitudes, when compared with that of tropical members of the same family, is found in other groups of birds, including wood warblers, swallows, and finches. Young North American House Wrens become independent of their parents about 13 days after quitting the nest; whereas young Southern House Wrens, especially of the season's last brood, may receive some food from their parents five weeks after leaving the nest.

Not only is the development of embryos and young speeded up in the northern species, the interval between broods is likewise diminished. In 57 instances observed by Kendeigh (1951:54), the interval between the first brood's departure from the nest and the female's beginning the second nest ranged from three days before the first brood flew to 17 days after they flew. Forty, or 70 per cent of all the records, showed an

interval of 7 to 13 days, with the largest number, nine, falling at 11 days. My own records on the interval between broods are more explicit with respect to the time elapsed to the laying of the first egg of the second brood than to the beginning of the second nest, because in many instances the old nest was merely relined to receive the second set of eggs. The North American House Wren may complete a late nest in two days. Even if we make the liberal allowance of five days from the beginning of building to the laying of the first egg of the second set, and add this to the values for the interval between broods given by Kendeigh, it will be seen that it is still considerably shorter than that for the Southern House Wren, which in my studies averaged 24.5 days.

In northern United States, the House Wren's breeding season extends from May to late July or August; and despite the acceleration of all parts of the reproductive cycle, only two broods can be raised in this period. With its far longer nesting season stretching from February or March to July, August, or even September, the Southern House Wren, despite its more leisurely program, succeeds in rearing three or four broods, laying three or four eggs for each. Thus the total number of eggs laid in a season, 11 to 16 in the more fecund pairs, equals or exceeds the 11 to 14 of the North American House Wren's two broods (Bent, 1948:121-122). It is unusual for a Central American bird to exceed in productivity its near relatives at high latitudes. Most of the passerine birds in this valley, producing each year only two or three broods of two or, less often, three eggs each, have a reproductive potential lower than that of members of the same groups nesting well beyond the tropics. This seems to be correlated with the lower mortality of birds which live the year around in a region of constantly flourishing vegetation and abundant insect life, as compared with those which must face either the hazards of a long migration or the rigors of a period of low temperatures and paucity of food (Skutch, 1949:432).

ACKNOWLEDGMENT

This paper was prepared while the writer held a fellowship of the John Simon Guggenheim Memorial Foundation of New York.

SUMMARY

This is a report of observations on the habits of the Southern House Wren (*Troglodytes musculus*) made in Central America and chiefly in Costa Rica, over a period of 20 years. In this region the species inhabits deforested lands ranging from sea-level to somewhat more than 9000 feet. The birds remain in pairs on their territories throughout the year.

The male sings more or less freely in all months, except while molting toward the end of the year. The female has a far simpler song, which she sings chiefly in response to her mate.

Adults when not nesting sleep singly in a great variety of nooks and crannies in trees, banks, houses, bunches of bananas, and other situations. The male commonly arises a little earlier, and retires a little later, than his mate.

At lower altitudes in Costa Rica, the breeding season sometimes begins at the end of December, more usually in February or March, and continues until August or September, thus including both dry and wet seasons, chiefly the latter. Cavities used for nesting are of the same great variety as those used for sleeping. Male and female together fill the chamber with many coarse sticks and straws. The lining of fibrous materials and then of feathers is applied chiefly by the female. The male sometimes helps with this, but may continue to bring sticks which get in his mate's way and are at times removed from the nest by her. Nest-building occupies about four to eight days. The female sometimes sleeps in the nest cavity before building begins.

Eggs are laid about sunrise on consecutive days. Central American sets consist usually of four eggs, often of three, very rarely of five, questionably of two. The size of the set bears no relation to the order of the season's broods.

Only the female incubates, taking many short sessions and recesses. She continues to bring feathers and bits of snakeskin during the period of incubation. The male comes from time to time to look into the nest. The incubation period is usually 14.5 to 15.5 days, rarely as much as 17. Eggs hatch at all hours of the day.

The male may begin to bring food to the nestlings within half an hour of hatching. The nestlings are fed small insects, spiders, and other invertebrates. The sexes take about equal shares in feeding, but the female alone broods.

The young remain in the nest about 18 days, often 19, seldom 17 or 20. They usually leave before eight in the morning, seldom after midday. Nine broods watched as they left took wing spontaneously, without parental urging.

As night approaches, newly emerged young are led by their parents to a dormitory, which is sometimes the nest itself but more often some sheltering cranny not far from it. Exceptionally the parents take the youngsters to roost in open nests of other birds. The parents go in and out of the chosen dormitory many times over, until at last the fledglings succeed in imitating them. After the young enter, the parents may feed them in the dormitory and remove droppings. The young may also be fed before leaving in the morning. The female may sleep with the fledglings or apart from them.

Young wrens find at least part of their food ten days after leaving the nest, but some, especially those of the season's last brood, may be given some food by the parents five weeks after leaving.

When the young are taken back to sleep in the nest space, they may continue this habit while the mother hatches out the next brood in the same cavity. From one nest they were forcibly evicted by the parents about the time the eggs hatched, and from another soon after hatching. At one nest, however, two young of the first brood persisted in sleeping with the nestlings despite parental opposition. After their parents began to tolerate them at the nest by day, these youngsters brought much food to the one nestling.

The young female who was feeding the nestling, when 73 days old, became antagonistic toward her female parent. After a day of fierce fighting, she was worsted and left the vicinity. The young male continued to attend its younger sibling until the latter was fledged. This fledgling of the second brood helped feed and otherwise attend nestlings of the third brood. This helper was feeding nestlings at the age of 54 days.

With two youngsters helping to feed a single nestling, the parents built a new nest in which the female started laying the season's third set of eggs six days after the one and only nestling left the second nest.

One young male was first heard singing when 34 days old, another at 46 days. The diffuse, rambling juvenile's song differs considerably from that of the adult's.

At lower altitudes in Costa Rica, a single pair may rear three or four broods in a year. One pair attempted six broods but raised only one. Leaving aside one extreme case mentioned above, the interval between the fledging of one brood and the resumption of laying ranged from 14 to 36 days, with an average of 24.5 days.

In 26 nests, 90 eggs were laid and 51 young fledged, giving a nesting success of 57 per cent. Ants were the only known cause of loss of nests.

The incubation period, nestling period, and interval between broods are substantially longer for the Southern House Wren than for the North American House Wren; but at lower altitudes its nesting season is so much longer that it produces three or four broods instead of the latter's two, and its annual production of eggs is the same or

greater. This is exceptional for birds of the humid tropics when compared with related species at high latitudes. The Southern House Wren has the highest reproductive potential of any passerine bird of Central America for which we possess adequate data.

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San Isidro del General, Costa Rica, August 16, 1952.

A YOUNG CALIFORNIA CONDOR

When the nestling California Condor is about 16 weeks old, as shown above, the pale orange color and frontal feathering of the head are similar to that of the adult. Four weeks later the skin of the head is dark bluish gray and the neck and occipital region are covered with short woolly down. The nestling shown is in a threatening attitude with feathers erected, and it is hissing at the photographer. Photograph taken in Sespe Canyon, Ventura County, California, on October 9, 1940, by Carl B. Koford.

FROM FIELD AND STUDY

Protracted Incubation Behavior of a Female American Goldfinch.—Near the University Arboretum in Ann Arbor, Michigan, on July 12, 1949, I found the basal portion of a nest of the American Goldfinch (*Spinus tristis*). When the nest was completed I do not know, but the first egg was laid on July 25; the last (fifth) egg was laid on July 29. The female was still incubating on August 19, but the nest had been abandoned by my next visit on August 25. The five eggs showed no visible sign of development. Walkinshaw (Jack-Pine Warbler, 16 (4), 1938:11) found that incubation by the American Goldfinch began "at nests of five eggs about the day the third egg was laid." Inasmuch as I did not determine when incubation began at this nest, it is necessary to assume that this female followed the general pattern reported by Walkinshaw, and, therefore, that incubation commenced on July 27. Thus, this female incubated the five eggs for a period of at least 23 days. This is nearly twice this goldfinch's normal incubation period of slightly less than 13 days (Walkinshaw, *op. cit.*).

Odum (Auk, 59, 1942:430-431) made careful observations on the nesting of a pair of Carolina Chickadees (*Parus carolinensis*) whose eggs failed to hatch after being incubated for 24 days. Odum stated: "Examination of the six eggs showed that no development has (*sic*) taken place in any of them." Schantz (Auk, 54, 1937:190) reported a Song Sparrow (*Melospiza melodia*) which incubated a clutch of three eggs for 24 days. When Schantz opened the eggs he found "half-grown embryos." Latham (Oölogist, 53, 1936:71) reported a female Catbird (*Dumetella carolinensis*) which incubated three eggs for 22 days. According to Latham these eggs "proved to be sterile." Byers (Wilson Bull., 62, 1950:136-138) described an interesting case in which a female Black and White Warbler (*Mniotilta varia*) incubated eight Cowbird (*Molothrus ater*) eggs a minimum of 19 days before the nest and eggs were destroyed. Nice (Trans. Linn. Soc. N. Y., 6, 1943:222-223) gave other records of unusually long incubation periods.

There is a paucity of precise information on the maximum length of broodiness behavior in passerine birds. It is interesting to note from the case histories here reviewed that the incubation period was in each instance approximately twice the normal period. Indeed, several of the nests were destroyed apparently while the females were still stimulated to incubate.—ANDREW J. BERGER, *Department of Anatomy, University of Michigan Medical School, Ann Arbor, Michigan, September 6, 1952.*

Food of the Common Merganser in Churchill County, Nevada.—The Common Merganser (*Mergus merganser*) occurs from November to March in the Lahontan Valley, Churchill County, Nevada. Only rarely has the species been observed in the area in summer. Nevertheless, adults with small young have frequently been seen at Pyramid Lake, about 50 miles northwest of the Lahontan Valley.

Between November 14, 1940, and March 14, 1945, 110 Common Mergenser stomachs were obtained for examination from the Lahontan Valley. The stomachs from 20 of these were found to be empty or contained fish remains that were digested beyond identification. Gravel up to ⅜ inch in diameter was found in some of the stomachs. The birds were obtained from seven general localities as follows: Carson River, from Lahontan Dam downstream to the river mouth at Carson Sink; irrigation canals, all within a radius of 10 miles of Fallon; Indian Lakes, 9 miles north-northeast of Fallon, a series of small lakes developed by fishermen; Rattlesnake Reservoir (an irrigation reservoir situated about 2 miles east-northeast of Fallon); Harmon Pasture (a small pond situated in a pasture about 5 miles east-southeast of Fallon); Hazen Reservoir (a small water supply reservoir situated approximately 2 miles south-southwest of Hazen; and Dutch Bill Lake (a lake situated approximately 5 miles north of Stillwater).

The total number of stomachs examined from each locality, together with the results of the analysis of the food contents is given in the accompanying table. Of the fish found in the stomachs, the carp were from 1 to 12¼ inches in length, the Sacramento perch were from 1¼ to 4½ inches, the yellow perch were all about 4 inches long, the suckers were all about 7¼ inches, the bullheads were all about 4½ inches, and the largemouth bass were from 2½ to 10 inches in length.

It is interesting to note that except in one instance the mergansers taken on the irrigation canals

and the Carson River, where the water is comparatively swift, contained a larger percentage of carp than those taken on ponds and lakes.

Of the total of 267 fish, or their remains, found in the stomachs examined, only 64 may be classed as game and food fish. This would indicate that approximately 76 per cent of the food of this merganser in this locality consists of rough fish that are not used by local persons for food.

Locality	Number of stomachs examined	Carp (*Cyprinus carpio*)	Sacramento Perch (*Archoplites interruptus*)	Yellow Perch (*Perca flavescens*)	Suckers (*Pantosteus* and *Catostomus*)	Catfish (Bullheads) (*Ameiurus*)	Other
Carson River	54	95	2	2	5	8	1 Red-striped Shiner (*Richardsonius*)
Irrigation canals	23	51	2	6	6	1	....
Indian Lakes	21	11	7	1	....	....	9 Largemouth Bass (*Huro salmoides*) 1 Bluegill (*Archoplites*) 1 Chub (*Siphateles obesus*)
Rattlesnake Reservoir	5	2	....	11	....	....	....
Harmon Pasture	3	17	....	....	1	....	....
Hazen Reservoir	3	13	14	....	....	....	....
Dutch Bill Lake	1	....	....	....	....	....	.... Copepods
	110	189	25	20	12	9	

I am indebted to Karl F. Lagler and Robert R. Miller who examined 46 of the stomachs at the University of Michigan in 1943. The remaining 64 were examined by the writer.—J. R. Alcorn, *Fallon, Nevada, September 4, 1952.*

Lapland Longspur and Snow Bunting Recorded in Utah.—On January 1, 1952, I had the opportunity to take a male Lapland Longspur (*Calcarius lapponicus alascensis*) while trapping Horned Larks (*Eremophila alpestris*) in my back yard at Roosevelt, Duchesne County, Utah. The Horned Larks concentrated at my feeding station during the extreme cold weather and heavy snowfall that occurred between December 28, 1951, and January 10, 1952. I did not recognize the longspur among the Horned Larks before it was captured. However, careful observations did not reveal others among the flock of approximately 200 Horned Larks that stayed in the vicinity. I extend my sincere thanks to Frank A. Pitelka for verifying the identification of the longspur. The specimen is now a part of the ornithological collection at the Brigham Young University, Provo, Utah. According to Woodbury, Cottam, and Sugden (Univ. of Utah, Bull. No. 16, 1949:39) this is the first record of the Lapland Longspur in Utah.

A male Snow Bunting (*Plectrophenax nivalis nivalis*) was captured, banded and later released at Roosevelt on January 2, 1952. It was observed feeding at the traps during the next two days but it did not reappear after January 4. A flock of 15 was observed feeding at a cattle feed yard near the Uinta River, 4 miles north of Fort Duchesne, Uintah County, Utah, from January 14 to February 10, 1952. A male was collected on January 14, 1952, and is now a part of the Brigham Young University collection.—Merlin L. Killpack, *Union High School, Roosevelt, Utah, September 16, 1952.*

Hybridization of Cinnamon and Blue-winged Teal in Northeastern California.—In northeastern California where the Cinnamon Teal (*Anas cyanoptera*) and the Blue-winged Teal (*Anas discors*) occur together during the breeding season, it is not surprising that these two closely allied species should occasionally be found to hybridize. Since the writers, however, are not aware that such a hybrid has ever been mentioned in ornithological literature from this region, the following observations may be of interest.

On May 12 and again on May 13, 1952, a perfect example of a male hybrid Cinnamon Teal x Blue-winged Teal was seen by the writers in a canal on Lower Klamath National Wildlife Refuge, Siskiyou County, California. The body coloration of this bird was similar to, though slightly paler than, that of a Cinnamon Teal, with indistinct round, black spots on breast and sides. A white crescent in front of the eye appeared to be almost as clear as that of a Blue-winged Teal.

On May 15, 1952, a male Cinnamon Teal and a male Blue-winged Teal were seen in characteristic courtship flight, both pursuing a female of one of the species. Blue-winged Teal are of fairly common occurrence, although by no means abundant, in this section of the state, apparently arriving somewhat later than the Cinnamon Teal. In 1952 the first sight record for the former was April 29. By this time a few Cinnamon Teal were already beginning to nest.—WILLIAM ANDERSON and A. W. MILLER, *California Department of Fish and Game, Tulelake, California, July 20, 1952.*

Additional Notes on Korean Birds.—From mid-November, 1951, to June, 1952, the writer was stationed with the United States Army at various points in Korea and was able to make a few limited observations of local birds. About thirty specimens were collected, but since the only guns available were M1 rifles, carbines, and an occasional 12-gauge shotgun, their condition is generally poor. Such skins as seemed salvageable have been deposited in the Museum of Vertebrate Zoology at Berkeley, where identifications were made.

Since the observations of Wolfe (Auk, 67, 1950:533-455) and Fennell (Condor, 54, 1952:101-110) are much more complete than mine, the following notes have been selected as supplementary. Principal observations were made in Kangwon Do , a few miles southeast of Kumsong and five miles south of the cease-fire line, and on the peninsula east of the harbor of the city of Pusan, in Kyongsang Namdo.

Anas crecca crecca. A female Eurasian Teal was taken by hunters on the Naktong River near Kumhae, north of Pusan, on March 14, 1952, along with a number of mallards.

Buteo buteo burmanicus. A male Japanese Buzzard was collected on December 3, 1951, south of Kumsong. It had been working through the deciduous woods along a ridge, and its stomach and gullet contained three small mice.

Synthliboramphus antiquus. Two males from a small flock of Ancient Murrelets were taken just outside of Pusan harbor on March 28, 1952. A small cove with nearly vertical walls of bare rock standing fifty to one hundred feet above the water protected the birds from a strong northwest wind, and they stayed close inshore or flew along the cliffs with several Black-tailed Gulls (*Larus crassirostris*). They were not seen after this date.

Otus bakkamoena ussuriensis. A female Scops Owl flushed from a stream bank into chest-high scrub pine along a mountain side east of Pusan on March 3, 1952. Her red eyeshine was clearly visible in the waning light. She never flew higher than the tops of the trees, and was shot while perched on a branch less than eighteen inches above the ground. The matted hair and bones of a single mouse were found in the stomach.

Dendrocopos kizuki acutirostris. On January 1, 1952, a male Pygmy Woodpecker was collected in a deciduous woods south of Kumsong, Kangwon Do.

Hirundo rustica. The first House Swallows were seen at Pusan on April 11, 1952, when a flock of about 15 flew in over a beach east of the city. From this time on they were common everywhere. A nest containing two eggs and two young was observed under the eves of a house at Sachon, Kyongsang Namdo, on May 31, 1952.

Cyanopica cyanus koreensis. A group of ten Blue Magpies was found in the brush along a small river near Kumsong on January 1, 1952, and one bird was taken. This species was not seen to associate with other birds in the valley, although crows and magpies were frequently together. A call of *chweee chweee* or *bzzzzzzz chweee chweee,* with a shrill rising inflection, revealed their movements through the brush.

Parus varius varius. A male Varied Tit was collected in the vicinity of Kumsong on January 1, 1952. While other tits and buntings flocked together through the brushy stream borders, this bird was found alone in a solitary oak near the center of the small valley.

Saxicola torquata stejnegeri. Pairs and individual Japanese Stonechats were seen occasionally in the first two weeks in April, 1952, in the vicinity of Pusan. They were generally to be found in brush and small trees along paddy margins or in steep-sided draws, in company with Meadow Buntings (*Emberiza cioides*) and Greenfinches (*Chloris sinica*).

Phoenicurus auroreus auroreus. A female Daurian Redstart was collected by pheasant hunters on March 30, in the vicinity of Kumhae, just north of Pusan. The ovary was enlarging, the follicles distinct.

Luscinia akahige. This record of the Japanese Robin is apparently the first for Korea. A single bird was flushed from a dense cluster of rose bushes along a small stream east of Pusan on April 11, 1952. Two were found in the same place on April 18, and a female was collected. These birds flushed very reluctantly and flew only short distances at a time, but they were very difficult to see since they stayed close to the ground in the depths of the thicket almost entirely. The female remained nearly motionless and invisible for fully five minutes, against a background of brown leaves on the ground but otherwise quite in the open, before I caught a slight movement of her head. These birds were probably stragglers. The ovary of the bird collected was small (6 × 4 mm.).

Regulus regulus japonensis. A male Golden-crowned Kinglet was collected at dusk on April 1, 1952, in a pine woods east of Pusan.

Emberiza elegans elegans. A male Yellow-throated Bunting was taken on January 1, 1952, near Kumsong from a small flock of tits and buntings in the brush along a stream.—RICHARD M. STRAW, *Rancho Santa Anita Botanic Garden, California, August 12, 1952.*

Erythrocyte Permeability and Bird Relationships.—Recently attention has been given to the delineation of animal relationships by using techniques derived from physiology and biochemistry. Prominent among investigators engaged in this work are Boyd and Boyden and Irwin (serology), McCabe and Deutsch (protein electrophoresis), and Jacobs and his co-workers (hemolysis). The latter (see, for example, Jacobs, Glassman, and Parpart, Jour. Exp. Zool., 113, 1950:277-300) have shown that the permeability of vertebrate red blood cells to certain penetrating solutes is similar within a vertebrate class and distinct between classes. Thus a bird's erythrocytes have permeability relations characteristic generally of the class Aves and differing distinctly from those of mammals, reptiles, amphibians, and fishes.

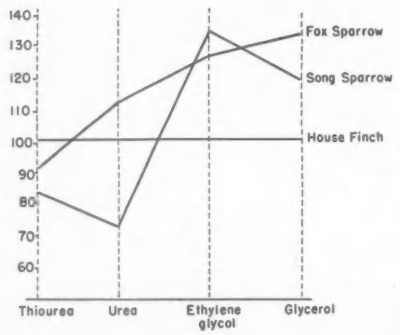

Fig. 1. Times of hemolysis of erythrocytes of House Finch shown as 100 per cent; times for Fox Sparrow and Song Sparrow shown as percentages of values for House Finch.

A current hemolytic theory holds that the configuration of the molecules on a cell surface will be partly reflected in the behavior of penetrating solutes at the cell surface. This surface configuration is sufficiently complex that only a portion of it will enter into the permeability relationships with any given substance. This accounts for the differences in time of permeability of various substances regardless of their shape or molecular weight. It is only to be expected that species which are considered close relatives on conventional grounds will be as "closely related" at the cellular level, and that they will reflect this in similar times of hemolysis for a particular solute. This report outlines a study made

to determine something of the usefulness of red cell permeability in avian taxonomy at the generic and specific levels.

The techniques used were those outlined in the paper by Jacobs, Glassman, and Parpart (*loc. cit.*). The penetrating solutions used were 0.3M thiourea, urea, glycerol, and ethylene glycol, all at *p*H 7.3. The time necessary for 75 per cent hemolysis in these solutions was determined by the use of a Coleman spectrophotometer and was measured by an electric timer.

Blood was taken from House Finches (*Carpodacus mexicanus*), Fox Sparrows (*Passerella iliaca*), and Song Sparrows (*Melospiza melodia*). The choice of species was partly one of convenience, as all were abundant in central California in January, 1952, when the study was made. An equally important reason for the choice is that by contemporary systematics the House Finch is placed in a different subfamily of the Fringillidae than are the sparrows; the latter are close enough that they are considered by some to be congeners (Linsdale, Univ. Calif. Publ. Zool., 30, 1928:367-368).

An inspection of the relationships displayed in figure 1 shows that even for only four solutes the sparrows have more affinities to each other than have they to the House Finch. Doubtless the use of a greater variety of solutes would show this affinity more precisely.

Times of hemolysis for the House Finch were: thiourea, 98–99.4 seconds (2 trials); urea, 118–138, mean 130 (3); glycerol 2.7–3.5, 3.0 (3); ethylene glycol, 3.7–4, 3.9 (2). For the Fox Sparrow: thiourea, 81–100, 91 (4); urea, 132–150, 149 (4); glycerol, 3.5–4.3, 3.9 (4); ethylene glycol, 5.1–5.6, 5.5 (4). For the Song Sparrow: thiourea, 81–87.7, 84.3 (2); urea, 75.4–103, 91.2 (4); glycerol, 3.7–5.0 4.1 (3); ethylene glycol, 3.6–5.7, 4.9 (5).

It would seem then that the potential worth of hemolysis in taxonomy at the level of genus and species in birds has been indicated; the need for additional investigations, however, is clear.—RICHARD F. JOHNSTON and BENJAMIN HOCHMAN, *Museum of Vertebrate Zoology and Department of Zoology, University of California, Berkeley, California, August 21, 1952.*

Rufous Hummingbird Nesting in California.—Since the summer of 1949 the writer has been sure that the Rufous Hummingbird (*Selasphorus rufus*) nested in the interior portion of the Trinity Mountains in northern California. In May of 1952, a female with nest and eggs were collected in extreme northeastern Humboldt County, California. Dr. Robert T. Orr of the California Academy of Sciences checked on the identification, and using the width of the outer rectrices, pronounced the bird *Selasphorus rufus*. The skin is now deposited in the collection of the California Academy of Sciences and the nest and eggs are in the Talmadge Collection. This is the first definite record of the nesting of this species in California.

The history of the search dates back into the ornithology of Humboldt County. For years, the older collectors that resided in the county believed the Rufous Hummingbird was nesting somewhere in the area. They based their assumption on the fact that although the Allen Hummingbird (*Selasphorus sasin*) was the common nesting species, many Rufous were seen during the breeding season. Nests and females were closely watched all over the region. The only unusual find were two nests of the Anna Hummingbird (*Calypte anna*) along the Mad River at Blue Lakes, in May, 1940, and on May 31, 1946.

In the early summer of 1949 the writer took up residence on the Trinity River. Judging by back coloration males of both Allen and Rufous hummingbirds were along the river. Field trips into the higher mountains east of the Trinity River revealed only the red-backed males. No specimens were taken as the peak of the normal nesting season had passed.

In late June of 1950 a field trip was taken to Trinity Summit, and a nest with large young was located. The female was observed closely and the two outer rectrices appeared to be very wide. No specimens were taken but the nesting site was marked.

In 1951 a more intensive search was carried on at the higher elevations, with the same result Another nest was located with young and marked. As in previous years, the nesting birds along the Trinity River proved to be the Allen, with the "red-backs" restricted to the mountains east of the river.

The late winter of 1952 was rather severe in the Trinity Mountains, but late in the spring a short field trip was made to snow line. It was found that many of the higher basins with either a southern or southwestern exposure were almost clear of snow. A search was made at the site of the nest that was found in 1950. On May 4, 1952, a nest with two fresh eggs with the incubating female was col-

lected at what is known as Mud Springs. This is a small meadow of about eight acres, with a southwestern exposure at an elevation of about forty-five hundred feet. It is in a dense stand of the white fir (*Abies concolor*). The meadow is centered by a small brush-covered swamp. Several small clumps of fir are scattered about the meadow, one edging the swamp. It was in this clump of firs, between the actual foliage of the trees and the brush that the nest was located.

The nest was saddled on a small dead twig that jutted at a slight angle below one of the lower branches. The nest was six feet above the ground, ten feet out on the limb, and two feet from the tip of the limb. The small structure was composed of a brownish moss, with three lichens tied on by cobwebs. The cobwebs are quite conspicuous, as they are a light gray, contrasting with the brown of the rest of the nest. The nest is lined with willow down. The measurements are maximum diameter 45 millimeters, maximum height 30 millimeters. There is nothing special about the nest or eggs to set it apart from others of the same genus of birds.

With the information that the writer has gained, it may be assumed that the Rufous Hummingbird is a sparse nesting species at the higher elevations in the interior Trinity Mountains. The breeding hummers from the lower elevations along the Trinity River have all turned out to be the Allens. Alden H. Miller (letter) states that he took this species at a nest at Hyampom on the South Fork of the Trinity.—Robert R. Talmadge, *Willow Creek, California, September 15, 1952.*

Additional Notes on the Birds of Santa Rosa Island, California.—Through the kindness of Mr. Ed Vail the writer together with Waldo Abbott was permitted to do some ornithological work on Santa Rosa Island, California. The period of March 15 to 28, 1951, was spent on the island, a total of 14 days. We worked the canyons and uplands from Skunk Point to Carrington Point, and inland for approximately four miles.

A special search was made for Rufous-crowned Sparrows (*Aimophila ruficeps*), but none was seen nor heard. The same type of habitat on Santa Cruz Island would have produced a number of this species. We concluded, therefore, as did A. H. Miller (Condor, 53, 1951:122), that breeding *Aimophila* are non-existent on Santa Rosa Island.

The following species were seen on different occasions, none of which has been specifically reported from Santa Rosa Island heretofore: Sharp-shinned Hawk, Marsh Hawk, Pigeon Hawk, Spotted Sandpiper, Sanderling, Black-bellied Plover and Herring Gull.

The following species were observed or collected; the specimens are now in the collection of the Santa Barbara Museum of Natural History.

Oreoscoptes montanus. Sage Thrasher. One was taken near Skunk Point. This bird was found in a patch of prickly pear cactus (*Opuntia*); when dissected it was found to have been feeding on small grasshoppers.

Regulus calendula cineraceus. Ruby-crowned Kinglet. Two female kinglets were taken by Abbott on March 18 and 21, respectively.

Vireo gilvus swainsoni. Warbling Vireo. Abbott collected this vireo in the canyon near the ranch house.

Dendroica coronata. Myrtle Warbler. One was shot but not retrieved on March 24.

Agelaius phoeniceus. Red-winged Blackbird. Three female Red-wings were seen in the corrals at the ranch house.

Molothrus ater obscurus. Cowbird. A female was taken by Abbott on March 27 at the ranch house. It was with some Red-winged Blackbirds.

Carpodacus purpureus californicus. Purple Finch. An immature male was taken near the ranch house. I saw an adult male in ranch house canyon.

Passerculus sandwichensis. Savannah Sparrow. Four were collected. Two proved to be *P. s. alaudinus* and two were *P. s. brooksi*. Thanks are due A. H. Miller for the racial identification of these birds.

All records have been evaluated by reference to Howell (Pac. Coast Avif. No. 12, 1917:1-127), Pemberton (Condor, 30, 1928:146-148), Willett (Pac. Coast Avif. No. 21, 1933:1-204), Grinnell and Miller (Pac. Coast Avif. No. 27, 1944:1-608).—Egmont Z. Rett, *Santa Barbara Museum of Natural History, Santa Barbara, California, July 15, 1952.*

Unrecorded Specimens of Neochloe brevipennis Taken in Oaxaca.—Ninety-five years ago Sclater described *Neochloe brevipennis* from Orizaba, Veracruz, and until just recently only six

specimens were known. Stresemann (Condor, 49, 1947:210) reported a seventh, and Loetscher (Condor, 54, 1952:204) an eighth. All were collected in Veracruz. A subspecies of this vireo, *Neochloe brevipennis browni,* was described by Miller and Ray (Condor, 46, 1944:41) from the region near Chilpancingo, Guerrero. According to the authors there are no significant differences in the wing, tail, or foot measurements, the length, depth, and width of the bill being the only varying dimensions. There are also differences in the plumage, especially on the lower back. This form is known from a single specimen.

It would seem worth while then to report eleven additional specimens of *Neochloe brevipennis brevipennis* in the University of Florida collection. These skins were taken by Mario del Toro Avilés from April 1 to May 26, 1949, at Amatepec, Oaxaca. Amatepec is located in the region of Mixe, which is part of the same cordillera forming the Nudo de Zempoaltepec. It is in the cold zone at an altitude of 2100 meters. Previously recorded altitudes for *brevipennis* are 4400 and 4500 feet; for *browni,* 4000 feet. The birds from Amatepec were taken at a much higher altitude therefore.

Bill measurements of these specimens vary considerably from those listed by Miller and Ray, although this is probably due in part to a difference in method. The discrepancy is especially clear in comparing the measurement of the middle toe, which is listed by Miller and Ray as 7.2–7.5 and by Ridgway as 11 mm. In regard to the plumage of the Oaxaca birds, the rump and the scapular region are slate gray with only a faint suggestion of olive green in some specimens. The white of the belly seems to vary greatly with the care used in preparing the skins. Two of my specimens show the extremes from extensive whiteness on the venter and sides to very little whiteness. The iris was recorded as white in all cases. The females of both forms were previously unknown. One of my birds is sexed as a female and does not differ in plumage from the males, as is true of most vireos.

The mean measurements with extremes of the ten males are: wing 56–60.3 (58.3), tail 53–56.5 (54.9), culmen from base 13.5–14 (13.8), length of bill from edge of nostril 7–7.7 (7.3), maximum depth of bill 4–4.9 (4.4), width of bill at nostril 3.9–4.7 (4.3), tarsus 19–21.5 (20.5), middle toe without claw 10–11 (10.5). One female measures: wing 57, tail 54.5, maximum depth of bill 4.4, width of bill at nostril 4.1, tarsus 20, middle toe without claw 10.3. Culmen from base and length of bill from edge of nostril could not be taken because of defects.—Marjorie A. Briggs, *Department of Biology, University of Florida, Gainesville, Florida, August 25, 1952.*

Three Cases of Twin Embryos in Passerine Birds.—During the course of field work at Ann Arbor, Michigan, from 1946 through 1951, I made observations on 96 nests of the Goldfinch (*Spinus tristis*) and 93 nests of the Song Sparrow (*Melospiza melodia*). From the data presented below it appears to me that one must conclude that in two of the former and one of the latter nests, two birds hatched from single eggs.

On April 27, 1946, I found a Song Sparrow nest containing four eggs. There were still four eggs on May 5, but the next day the nest contained two eggs, two nestlings (about the same size), and about one-half of an intact egg (the pointed end) containing a fully-formed, but dead, embryo. This embryo was about the same size as each of the two nestlings. On May 7, the nest still contained two eggs (which did not hatch) and two nestlings, but one of the latter was nearly twice the size of the other. The smaller nestling disappeared between 6:00 p.m., May 8, and 7:45 a.m., May 9. The larger nestling fledged on May 16. It seems likely that the smaller nestling was one of the twins. It is interesting to note that when I inspected the nest on the day that the eggs hatched (May 6), all egg shell had been removed from the nest except for the half containing the dead embryo.

P. B. Hofslund called my attention to a female Goldfinch constructing a nest on July 11, 1949. The nest contained two eggs on July 21; five eggs on July 25 and 28, and August 3. When I inspected the nest on August 4, I found four young birds and two eggs. There were six young in the nest on August 6, but on August 15, there were only four. These fledged on August 20.

On August 11, 1949, I found a Goldfinch nest with five heavily incubated eggs. Two days later there were four young (down still wet on one) and two eggs. Unfortunately, this nest was later destroyed (before August 15).

For passerine birds, I know of only one previous reference to twin embryos reaching the stage of hatching. Cartwright (Canad. Field Nat., 53, 1939:122) reported an egg of the Brown Thrasher (*Toxostoma rufum*) which was found on the ground below the nest. Cartwright stated that: "The embryos had reached the point of hatching, but had apparently been unable to break their way out

of the egg. Both embryos were perfectly formed and one was only slightly smaller than the other."

I have no doubt that twins hatch more frequently than these four records indicate. In cases where twins do hatch, individual marking, and later banding, of the nestlings would enable one to gather data on the viability of the twins. Observers working on life histories where daily visits are made to nests obviously have the best opportunity to add to our knowledge of this subject.—ANDREW J. BERGER, *Department of Anatomy, University of Michigan Medical School, Ann Arbor, Michigan, September 29, 1952.*

Wilson Phalaropes as Commensals.—Though a few species of birds such as Frigate Birds and Bald Eagles are well known for their parasitism on other birds, Wilson Phalarope (*Steganopus tricolor*) has not been previously reported, so far as I know, as a species whose food on occasion was provided through efforts of another species. On September 5, 1951, near Olmita, in southernmost Texas, I noticed about 50 Avocets (*Recurvirostra americana*) and 400 Wilson Phalaropes feeding in a large, shallow pond. The water was of such a depth that the Avocets could wade, but the phalaropes, with their shorter legs, had to swim. Evidently the feet of the Avocets were stirring up food from the bottom. Each Avocet was accompanied by, or sometimes completely surrounded by, a small cluster of swimming phalaropes, all excitedly pushing and crowding the Avocets and one another as they snatched at the food floating up from the bottom. Each of the Avocets was providing food for at least a few phalaropes, and one Avocet was providing for no less than 46. The Avocets did not seem to object to the robbery, if that is what it was, or to the crowding. No bird struck another except accidentally in the scramble, and there were no quarrels or fights.—GEORGE G. WILLIAMS, *The Rice Institute, Houston, Texas, November 25, 1952.*

Dipper Eaten by Brook Trout.—Bent (U. S. Nat. Mus. Bull. 195, 1948:111) lists the water snake and several stream-frequenting mammals as predators of the Dipper (*Cinclus mexicanus*). I identified the partly digested remains of a fledgling bird of this species from the stomach of a male brook trout (*Salvelinus fontinalis*) caught by W. V. Woodbury at Hunter Creek, Washoe County, Nevada, in July, 1945. The Dipper was tightly compressed into the stomach, and the approximate size of the bird at the time of the capture by the fish could not be judged. The trout was merely ten inches long, but it was capable of the predation by use of its relatively cavernous mouth. Mortality of this type could be high among Dippers on streams where the bird is closely associated with large fishes.—NED K. JOHNSON, *University of Nevada Museum of Biology, Reno, Nevada, November 3, 1952.*

Notes on the Red Crossbills of the Uinta and Wasatch Mountains, Utah.—Indications are that Utah is an area where several races of the Red Crossbill (*Loxia curvirostra*) meet (Woodbury, Condor, 41, 1939:162, and Behle, Condor, 46, 1944:84). An understanding of the geographic distribution of the races is complicated by the irregular breeding habits and erratic wanderings of this species. The situation in the Uinta Mountains in northeastern Utah illustrates these features.

Twomey (Ann. Carnegie Mus., 28, 1942:464) found breeding crossbills at Green Lake, Daggett County, during June-July, 1937, and obtained 23 specimens, which were referred to *benti*. Of these, he listed nine showing certain characteristics of *grinnelli*. Also, a series (Zoology Museum of Brigham Young University) from Lost Lake, Uinta Mountains, August, 1940, was identified by Ludlow Griscom as *benti*.

In 1950, I collected a new series as follows: 26 specimens at Lake Fork Mountain, 10,000 feet, 32 miles north of Duchesne, Duchesne County, June 17-20, and three at Timothy Creek, 7,500 feet, 10 miles north of Altonah, Duchesne County, June 23-25. These specimens were deposited in the Museum of Zoology of the University of Utah (U.U.M.Z.). At Lake Fork Mountain the birds occurred in the Engelmann spruce-alpine fir forest, while those at Timothy Creek frequented stands of yellow pine.

Despite the time of year, these birds were not breeding. Rather, they occurred in large flocks composed of adults and juveniles, were moderately to very fat, and had gonads which were in a reduced condition. The left testis of 19 fully adult and first-year adult males averaged 1.5 mm. in length, and the average diameter of the ovary of seven adult females was 3 mm. One male and one female of the series are in striped juvenal plumage. Both had a large transparent area in the roof of the braincase.

The adult females and several fully adult and first-year males were molting, having one to four fully grown new or ensheathed primaries and patches of new feathers on the head. Other parts of the plumage showed considerable wear and fading. Each adult female had a brood-patch, but the skin in that area was only slightly edematous. These data suggest that the birds had nested earlier in the year.

According to Tordoff (Condor, 54, 1952:200-203), fully adult males in red plumage differ from red first-year males in having the edgings of the remiges and rectrices pinkish instead of greenish. Using this distinction, it was possible to identify eight fully adult and four first-year adult males among the 17 red males in my series. The remaining six have these edgings so worn and faded that it is impossible to determine their original hue. Two other males are in xanthochroistic plumage.

As a series these crossbills were assigned to *bendirei* with which race they agree in average length of wing and depth of bill. This opinion was shared by Ludlow Griscom, to whom they were later submitted. As regards length of culmen, however, they average a bit too long for "good" *bendirei* and approach the size of either *benti* or *grinnelli* (table 1). Their connection with *benti* seems to be ruled out by the fact that none of the males has the rosier coloration characteristic of that race (Griscom, Proc. Boston Soc. Nat. Hist., 41, 1937:129). One first-year adult male (U.U.M.Z. 10800) is exceedingly small and approaches the size of *sitkensis* (table 1). It is, nevertheless, probably best considered an extreme variant of the population represented by the other birds of the series. One other example of *bendirei* from the Uinta Mountain area is a male (U.U.M.Z. 10069) taken from a cottonwood tree 3 miles south of Vernal, Uintah County, June 18, 1949.

Table 1

Measurements of *Loxia curvirostra* in Millimeters

Males—	Number	Age	Wing	Tail	Bill depth	Culmen
Loxia c. bendirei[1]			86.5–94		9.0–10.5	15.0–18.5
Wasatch Mts. (July, 1949)	1	?	92.2	56.8	10.2	18.0
Uinta Mts. (June, 1950)	8	ad.	92.7	55.0	10.0	18.0
			(89.4–95.7)	(52.8–57.6)	(9.1–10.5)	(16.7–18.8)
" " " "	3	f.y.	92.0	53.7	9.4	18.3
			(90.2–93.2)	(51.4–56.9)	(9.2–9.6)	(17.9–18.7)
" " " "	1	f.y.[2]	83.8	50.2	8.2	15.0
" " " "	5	?	93.9	55.0	9.8	18.3
			(91.5–97.3)	(53.1–57.5)	(9.5–10.0)	(17.9–18.9)
" " (Sept, 1950)	1	f.y.	98.4	60.1	11.1	19.0
Loxia c. grinnelli[1]			92.0–97.5		10.3–11.5	17.5–19.0
Females—						
Uinta Mts. (June, 1950)	8	ad.	90.0	53.2	9.8	18.2
			(87.2–93.1)	(49.0–56.7)	(9.3–11.0)	(16.8–19.1)
" " (Sept., 1950)	1	ad.	98.5	60.1	11.1	18.7

[1] Griscom (*op. cit.*:139)
[2] Variant resembling *sitkensis*.

In view of the foregoing, it is noteworthy that a pair of Red Crosbills, probably breeding, taken in the Uinta Mountains in a yellow pine forest at Hideout Canyon, 9,000 feet, Daggett County, September 13, 1950 (three months after I had collected the first series), are typical *grinnelli* both as regards size and coloration (table 1). The left testis of the male, which is a first-year adult, measured 5 mm. in length, and the oviduct of the female contained a 10 mm. egg. Several other crossbills were seen near Hideout Canyon on the same date.

Incidentally, while Red Crossbills are frequently of common occurrence in the Uinta Mountains, they are rare in the neighboring Wasatch Mountains in the north-central part of the state. As far as I am aware, only one specimen has been reported from that area, namely an example of *bendirei* from Logan Canyon, Cache County, March 25, 1933 (Stanford, Proc. Utah Acad. Sci., Arts and Letters, 51, 1948:144). I obtained an adult male in the Engelmann spruce-alpine fir forest at Silver Lake Post Office (Brighton), 10,018 feet, Salt Lake County, on July 19, 1949. The left testis was 4 mm. long.

The specimen is an xanthochroistic example of the race *bendirei*.—ROBERT K. SELANDER, *Museum of Vertebrate Zoology, Berkeley, California, November 20, 1952.*

American Golden-eye in Sonora, Mexico.—While on a collecting trip during the month of February, 1951, I observed a pair of American Golden-eyes (*Bucephala clangula*) on a small lagoon three miles north of Guaymas, Sonora, Mexico. These birds swam about on this lagoon for the 10 days that we camped at Guaymas, and we had abundant opportunity to observe them. This species is not listed by van Rossem in his distributional survey of Sonoran birds (Occ. Papers Mus. Zool., Louisiana State Univ., no. 21, 1945).—ERNEST S. BOOTH, *Walla Walla College, College Place, Washington, April 30, 1952.*

Additional Bird Records from Southern Nevada.—The following records are noteworthy in as much as they either add to the list of native birds known to occur in Nevada or add distributional information on species rarely recorded from Nevada.

Mountain Plover (*Eupoda montana*).—Supplementing an earlier record (Gullion, Condor, 54, 1952:204) is an observation of a single bird of this species flushed from the shoulder of U. S. Highway 95 about nine miles southeast of Beatty, Nye County, on October 1, 1952. It was accompanied by a smaller, unidentified shore-bird.

Inca Dove (*Scardafella inca*).—On October 17, 1952, I saw a dove of this species in the center of Logandale, Clark County. It was not possible to attempt to collect this bird, but prolonged observation at very close range left no doubt as to the species identification. This dove has not been reported from Nevada previously.

Ground Dove (*Columbigallina passerina*).—On November 21, 1952, a dove of this species was collected in an *Atriplex lentiformis-Prosopis juliflora* (quailbrush-honey mesquite) thicket, at 1800 feet elevation, about four miles east of Las Vegas, Clark County. This specimen, a male, is now number 126599 in the collection of the Museum of Vertebrate Zoology, University of California. This species has not been reported from Nevada previously.

This dove was foraging on the ground and its crop contained approximately 2640 (1.3 cc.) seeds of a small-seeded *Amaranthus* (pigweed); 150 (0.3 cc.) seeds of *Sphaeralcea* sp. (globe-mallow); and nine seeds of *Amaranthus albus*.

White-throated Sparrow (*Zonotrichia albicollis*).—A second record for the state of Nevada is based upon an immature plumaged (but with double-layered skull) male taken in a quail trap with a dozen or so White-crowned Sparrows east of Las Vegas on November 25, 1952. This specimen is now number 126608 in the collection of the Museum of Vertebrate Zoology. It was an exceedingly fat bird.—GORDON W. GULLION, *Nevada Fish and Game Commission, Boulder City, Nevada, November 30, 1952.*

The Breeding Distribution of Chordeiles minor in Mexico.—At the time of Oberholser's revision of the subspecies of *Chordeiles minor* in 1914 (Bull. U. S. Nat. Mus., 86), the southernmost known limits of the continental breeding range of this species were based on a specimen of *henyri* from Babícora, central-western Chihuahua, collected on June 21, 1902, and examples of *aserriensis* from Matamoros, extreme northeastern Tamaulipas, taken August 15 and 23, 1908. In the "Distributional Check-list of the Birds of Mexico. Part I" (Pac. Coast Avif. No. 29, 1950:153), Friedmann, Griscom, and Moore extended the known breeding range of *henryi* south to Nombre de Dios, southern Durango. More recently two breeding birds were reported by Webster and Orr (Condor, 54, 1952: 310) from southern Durango (5 miles east of Cerro Prieto, and 29 miles west-northwest of Ciudad Durango; specimens examined at the California Academy of Sciences through the courtesy of Dr. Robert T. Orr).

Evidence is now at hand which indicates that the species breeds much farther south on the mainland of México than was formerly supposed. Dr. Alden H. Miller (MS) noted this species on July 1, 1952, in a tropical forest region 6 miles east of Nuevo Morelos, 1,600 feet, southwestern Tamaulipas. Warner and Mengel (Wilson Bull., 63, 1951:292) reported seeing and hearing *C. minor* every evening from July 15 to 28, 1942, over Boca del Río, Veracruz. An immature female collected there on July 23 was tentatively referred to *aserriensis* by Dr. Wetmore. Warner and Mengel also cited a reference in Loetscher's unpublished thesis "Ornithology of the Mexican State of Veracruz"

(Cornell Univ.) to a female specimen (identified by Dr. Oberholser and others as *chapmani*) in the Princeton Museum of Zoology which was taken from a nest with two eggs on the beach near the city of Veracruz on July 5, 1930. Davis (Condor, 55, 1953:91) reported observations of this species on July 26 and 29, 1951, at a camp 3 miles north of Tzitzio, Michoacan.

Working in the state of Chiapas, one of us (Alvarez; see Condor, 54, 1952:113) found a breeding pair on June 25, 1947, at Meseta Copoya, 4.3 miles south of Tuxtla Gutiérrez and collected an adult female with a newly hatched chick, July 2, 1949, at Rancho Santa Julia, 9.3 miles north of Ocozocoautla. He also obtained two adult males at Rancho Santa Julia on April 24, 1949.

Meseta Copoya is a region of rolling flats sparsely covered with groves of broad-leafed trees lying within the Arid Lower Tropical Zone at an altitude of between 1970 and 2300 feet. During the summer nighthawks of this species are commonly seen flying at dusk here and in the general vicinity of Tuxtla Gutiérrez.

Rancho Santa Julia is situated at an altitude of 3576 feet in a region of low hills characterized by grassy slopes intermixed with thick groves of broad-leafed trees. The climate is humid and the region is frequently covered with fog. *Chordeiles minor* occurs here in fair numbers throughout the year but is more numerous in the summer. This nighthawk also may nest in the open fields near the tropical jungles at El Ocote, 25 miles northwest of Ocozocoautla, where it has been observed in June and August.

The specimens from Chiapas have been compared with examples of the North American races of this species in connection with a study of the western North American forms by Selander (MS). In color the adult female is quite unlike either *henryi* of northern México, Arizona, and New Mexico, or *aserriensis* of northeastern México and southern Texas, lacking for the most part the rufescent or tawny markings of the former and the abundant ashy vermiculations of the latter. Curiously enough, the specimen closely approaches some darker variants of *hesperis* from Nevada and California, especially in having the dorsal mottles coarse and whitish. The under parts are washed with dull gray-brown which is of a shade not exactly matched by specimens of *hesperis*. The specimen is smaller than the average of *henryi* or *hesperis*, especially in length of tail, and approaches *aserriensis* in this respect. The two adult males (which, considering the date of their collection, may have been migrants) have some of the rufescence of *henryi* but differ from most examples of that race in having coarser and more sparsely distributed dorsal mottles and in being less tawny ventrally, especially on the breast. All the Chiapas specimens have thinner and less numerous light bands on the two central rectrices than do examples of *hesperis* and *henryi*, the tail appearing much darker in general aspect. The white wing-patch of the male is very small and does not extend to the outer web of the two outer primaries. Specimens of *henryi* occasionally show this condition but generally have a somewhat larger wing-patch than is seen in the Chiapas birds.

The foregoing records suggest that *C. minor* breeds locally throughout México (excluding Lower California and the Yucatan peninsula). The breeding range possibly extends south through Central America in view of the circumstance that Eisenmann (Wilson Bull., 63, 1951:184) reported seeing and hearing this species "every evening of June and July in 1948, 1949, and 1950" in Juan Franco, a suburb of Panama City, Panama. This note has been prepared with the intention of pointing out the gaps in present knowledge of the distribution and geographic variation of this species in the southern portion of its range in the hope that ornithologists working in México and Central America will make special effort to obtain additional specimens and observations.—ROBERT K. SELANDER, *Museum of Vertebrate Zoology, Berkeley, California,* and MIGUEL ALVAREZ DEL TORO, *Museo Zoologico, Tuxtla Gutiérrez, Chiapas, México, February 14, 1953.*

English Sparrows Nesting within Nest of Red-tailed Hawks.—During the latter part of April, 1952, a pair of Red-tailed Hawks (*Buteo jamaicensis*) was observed nesting in a grove of valley oaks (*Quercus lobata*) on the J. E. Montgomery Ranch three miles southeast of Davis, California. The hawks were using an old nest, fifty feet above the ground, used in the previous year. When revisited during the early part of June, the nest contained four downy young Red-tails. While examining the ground below the nest, a familiar chirping of young English Sparrows (*Passer domesticus*) was heard coming from above. Binoculars disclosed a bulky grass nest interwoven among the large sticks and twigs of the Red-tails' nest. The entrance to the sparrow nest opened to the south and was within a foot of the young hawks.

The following week William Kirsher of the Sacramento Audubon Society climbed to the nest and banded the four young hawks. Trevenen J. Taylor of Davis took motion pictures of the banding operation, and on subsequent visits he was able to get several scenes showing the female sparrow perched outside her nest with the young Red-tails only several inches away. No observation was made of the adult birds of both species at the nest at the same time. The hawks seemed tolerant of the sparrows, but it was not learned if the young sparrows left the nest. The young hawks left the nest successfully during the latter part of June.—G. VICTOR MOREJOHN, *Davis, California, December 23, 1952.*

A Palm Warbler in Autumn at Point Lobos Reserve, California.—On October 9 and 27, 1952, at Point Lobos Reserve, Monterey County, California, I observed a warbler which at first I took to be an Orange-crowned Warbler. On the second date, however, the bird was in clear view within ten feet of me and on a grass lawn in company of about twelve Audubon Warblers. The reddish brown on top of the head and upper back, the conspicuous whitish line over the eye, the brownish-grey breast streaked with dark markings, and the decidedly yellowish under belly and under tail coverts were seen clearly. These characters, along with the mannerism of continuously wagging the tail up and down, made me conclude that the bird was a Palm Warbler (*Dendroica palmarum*). Previous records of this bird in California were at Pacific Grove, October 9, 1896 (Emerson, Osprey, 2, 1898:92) and Furgeson Lake, Imperial County, September 22, 1942 (Monson, Condor, 46, 1944:22). —KEN LEGG, *Point Lobos Reserve State Park, Carmel, California, December 12, 1952.*

NOTES AND NEWS

A meeting for presentation of scientific papers, sponsored by the Cooper Ornithological Society, will be held in conjunction with the forthcoming meetings of the Pacific Division of the American Association for the Advancement of Science at Santa Barbara, California, June 15 to 20. The Society's meeting will occur on Saturday morning, June 20, beginning at 9 a.m. on the campus of Santa Barbara College.

Organization of a program for this meeting is now in progress. Information concerning the program may be obtained from Dr. John Davis, Moore Laboratory of Zoology, Occidental College, Los Angeles 41, California. Persons wishing to participate should write to him.

Other sections of these general meetings of the AAAS will also be of interest to ornithologists and naturalists. Some field trips will be held. A preliminary announcement listing all participating organizations and the proposed programs may be obtained by writing to Dr. R. C. Miller, California Academy of Sciences, Golden Gate Park, San Francisco, California.

The forthcoming meetings of the American Ornithologists' Union to be held at Los Angeles, California, are scheduled to take place from Wednesday, October 21, through Sunday, October 25. Wednesday, the 21st, will be taken by business meetings. Thursday, Friday and Saturday will be devoted to papers and symposia. The annual banquet will occur on Saturday evening. A field trip is planned for Sunday.

PUBLICATIONS REVIEWED

THE STUDY OF INSTINCT. By N. Tinbergen. Oxford University Press, xii + 228 pp., 130 figs. 1951. $7.00.

At this writing, Tinbergen's book on instinctive behavior has not yet received the attention due it in American ornithological journals. It seems as though semipopular and more or less anthropomorphic writings on birds, not particularly challenging to our abilities to assimilate new ideas and facts, get more space on review pages than fundamental contributions. Critical reviews of more or less popular works, certainly important in themselves, will reach their proper audience not in leading scientific journals but in less specialized journals and magazines with greater appeal and interest to the general public.

It is a pleasure to describe and discuss Tinbergen's book. Well written, with elegant development of ideas and arguments, courageous in challenging faulty views and procedures, calm and confident in style, yet stimulating, the book should be read by anyone interested in the behavior of birds. Tinbergen is the present-day spokesman of a school of animal behaviorists developed by Lorenz and arising primarily from the early work, from 1900 to 1920, of C. O. Whitman at the University of Chicago and of the German ornithologists, Oskar and Magdalena Heinroth. The objective is to study innate behavior rather than learned or conditioned behavior. Certainly the latter is unavoidable in the study of innate behavior, and the distinction of the Lorenz-Tinbergen school arises out of point-of-view and method rather than subject matter. The two men are primarily environmentalists and evolutionists; they are naturalists in the best modern sense. They want to know how an animal responds to stimuli arising in its normal habitat and what it can and does learn *there*. At once, then, they differ from the majority of psychologists who want to know what an animal (usually the rat, or mouse, or some other tractable mammal) is *capable* of learning (usually in a pen or cage) and what pathologies can be detected or induced in it.

The book is organized around six questions to be asked about any particular act or behaviorism. (1) What external factors stimulate it? (2) What internal factors can stimulate, modify, or control it? (3) What part does the behavior play in a total pattern integrated by the nervous and muscular systems? (4) When does it appear and what is its place in the development and maturing of behavior in the individual? (5) What is its functional or adaptive significance? And (6) what is its place in the evolution of behavior? A chapter is devoted to each of these basic questions except for a division into two chapters of the material on external factors, the more complicated aspects of which are taken up after discussion of internal factors and "spontaneous" behavior. An introductory chapter orients the reader well with regard to objectives, the relation of the book to other types of research on behavior, and the relation of the study of behavior, or ethology, to other biological disciplines.

The main conclusions of the book deal with

the interplay of external and internal causal factors underlying behavior patterns, such as nest-building and mating, each with subordinate components and each in turn part of a total of behavior patterns that function in satisfying a basic drive, as that of reproduction. There are imporant theoretical discussions of "innate releasing mechanisms" and of a "center theory" of instincts; but the parts of the text that will help the field worker right now in sharpening his thinking on behavior and in focussing attention on elusive points are the chapters dealing with internal and external factors and the one dealing with adaptiveness of behavior. There are excellent ink drawings scattered throughout the text, and the frontispiece photograph of a threatening stickle-back fish helps to open the text in an effective manner. Perhaps the only serious complaint about the book is its price, which for so small a book is unreasonably high.

There are two other recent books on behavior which should be mentioned here. The first is Lorenz's "King Solomon's Ring," a popular account of some of the author's researches on a variety of animals, but particularly birds. Humanistic, warm, and entertainingly written, this book appeals to a wide range of readers. It was a non-fiction choice of a book-club in England, where the book was published in 1952 by Methuen and sold for $2.25. In the United States, it is distributed by Crowell Press and sold for $3.50.

The second book is a symposium collection of papers entitled "Methodology and Techniques for the Study of Animal Societies" (Annals of the New York Academy of Sciences, 51:1001-1122, 1950). There are eleven papers dealing with various aspects of research procedure in the field of behavior. Included are papers by J. T. Emlen on techniques of observing bird behavior, one by N. E. Collias on social life, and one by John W. Scott on comparative studies of three species of grouse. The price is $2.50. This group of papers provides a very useful guide for students of behavior.—FRANK A. PITELKA.

BETWEEN PACIFIC TIDES. By Edward F. Ricketts and Jack Calvin. Third edition; revised by Joel W. Hedgpeth. Stanford Univ. Press, xiv + 502 pp. 1952. $6.00.

This excellent book on the invertebrate animals of the intertidal zone along the Pacific Coast, particularly the Californian coast, should be known to all ornithologists interested in the ecological settings in which they observe birds of beaches, rocky coasts, mudflats, bays, and inshore waters. The latest edition of this book, well-known among marine zoologists, was prepared by Dr. Hedgpeth of the Scripps Institution of Oceanography at La Jolla, California. It retains all the good features of previous editions and also provides a new chapter on intertidal zonation and a thoroughly re-worked and interestingly annotated bibliography. The latter is in effect a guide to literature on marine life of the Pacific Coast. There are about 200 illustrations, mostly of invertebrate animals and their habitats. About birds *per se* this book says very little, but it is an invaluable source of information on bird habitats of the coast proper, on the food resources and conditions in these habitats, and on the geography of the coast line generally.—F.A.P.

COOPER SOCIETY MEETINGS

NORTHERN DIVISION

NOVEMBER.—The monthly meeting of the Northern Division of the Cooper Ornithological Society was held on November 6 at the University of California, Berkeley.

The speaker of the evening, Mr. Merton N. Rosen, Parasitologist with the California Department of Fish and Game, presented a survey of Progress in Wildlife Disease Control.—ROBERT K. SELANDER, *Acting Secretary*.

DECEMBER.—The monthly meeting of the Northern Division of the Cooper Ornithological Society was held on December 4 at the University of California, Berkeley. Mr. Elmer E. Highley, Monterey Union High School, Larkin Street, Monterey, California, was proposed for membership by Mr. Laidlaw Williams.

A committee to nominate officers of the Northern Division was appointed consisting of Mrs. Harold C. Austin (chairman), Dr. A. Starker Leopold, and Mr. Paul F. Covel.

Oliver P. Pearson narrated a colored motion picture on The Animal Life of the Altiplano of Peru.—ROBERT K. SELANDER, *Acting Secretary*.

JANUARY.—The monthly meeting of the Northern Division of the Cooper Ornithological Society was held January 8, 1953, at the University of California, Berkeley. Mr. Donald W. Humphrey, Box 664, St. Maries, Idaho, was proposed for membership by Frank A. Pitelka.

The Nominating Committee presented the following slate of officers for 1953: Robert T. Orr, president, Charles G. Sibley, first vice-president, T. Eric Reynolds, second vice-president, and Robert K. Selander, secretary. There being no

further nominations, on a motion from the floor the slate of officers was accepted and an unanimous ballot cast.

Mrs. T. Eric Reynolds presented a colored movie, "Western Discovery: A Nature Travelog from the West Coast of Mexico to Puget Sound." —ROBERT K. SELANDER, *Secretary*.

FEBRUARY.—The monthly meeting of the Northern Division of the Cooper Ornithological Society was held February 5, 1953, at the University of California, Berkeley. Richard E. Warner, Rt. 2, Box 502, Morgan Hill, Calif., was proposed for membership by Charles G. Sibley.

Mr. Wallace G. MacGregor discussed "Recent Developments in California Quail Management." —ROBERT K. SELANDER, *Secretary*.

MARCH.—The monthly meeting of the Northern Division of the Cooper Ornithological Society was held on March 5, 1953, at the University of California, Berkeley. The following memberships were proposed: Monte O. Cheney, Route 3, 2218 Linden, Caldwell, Idaho, by A. H. Miller; and George F. Townes, 500 Summer St., Greenville, South Carolina, by F. A. Pitelka.

Dr. Robert T. Orr presented an illustrated talk on "Summer Observations in Northern Baja California."—ROBERT K. SELANDER, *Secretary*.

APRIL.—The monthly meeting of the Northern Division of the Cooper Ornithological Society was held on April 2, 1953, at the University of California, Berkeley.

Dr. Carl B. Koford spoke on "Tinamous and Other Birds of the Central Andes."—ROBERT K. SELANDER, *Secretary*.

SOUTHERN DIVISION

NOVEMBER.—The monthly meeting of the Southern Division of the Cooper Ornithological Society was held November 25, 1952, at the University of Southern California. The following names were proposed for membership: C. Mortimer Palmer, Jr., P. O. Box 414, Tombstone, Ariz., by J. W. Wright; S. S. Whitehead, Box 393, Corcoran, Calif., by C. H. Anderson; Robert E. Blackstone, 8572 Holloway Dr., Los Angeles 46, Calif., Norman H. Mellor, M.D., 2724 Garretson, Corona, Calif., and Harry Yurick, 948 W. 4th St., Hazelton, Pa., all by J. C. von Bloeker, Jr.; Theodore Downs, L. A. County Museum, Exposition Park, Los Angeles 7, Calif., William J. Evans, 541 N. Citrus Ave., Covina, Calif., John H. Foster, Box 204, Wayne, Pa., Mrs. Harry B. Humphrey, 715 West Fremont Ave., Mountain View, Calif., Ralph A. MacMullen, Box 97, The Heights, Mich., John J. Morony, Jr., P. O. Box 1114, Alamo, Texas, Miss Hattie K. Milner, 331 E. Gowen Ave., Mt. Airy, Phila. 19, Pa., J. E. Retief, 56 Lincoln St., Bellville, Cape Province, South Africa, Dr. Maurice A. Shellim, 7 Middleton Mansions, Calcutta 16, India, Alexander Sprunt IV, 1051 Cragmont Ave., Berkeley, Calif., Harry Madison Smith, Dept. of Zoology and Physiology, University of Wyoming, Laramie, Wyoming, and Raymond Russell Super, 164 Maple Ave., W. Marrayunk, Phila. 27, Pa., all by C. V. Duff.

At the request of the president, the following Nominating Committee was appointed: C. V. Duff, J. R. Pemberton and Ed N. Harrison.

Dr. Jean Delacour, speaker of the evening, and President of The International Committee for Bird Preservation, described the meeting held by that body in Caracas, Venezuela, last summer.—DOROTHY E. GRONER, *Secretary*.

JANUARY.—The monthly meeting of the Southern Division of the Cooper Ornithological Society was held January 27, 1953, at the University of Southern California. The following names were proposed for membership: Barbara Ellen Huber, 1753 Correa Way, Los Angeles 49, Calif., by Wade Fox; James Roger King, Dept. of Zoology, State College of Washington, Pullman, Wash., by Donald S. Farner; Ray B. Lyon, 1290 Foothill Blvd., San Luis Obispo, Calif., by Ian I. McMillan; William Winston Mair, Canadian Wildlife Service, Dept. of Resource and Development, Ottawa, Ontario, Canada, and Ray Thomas, 600 Sarbonne Rd., Los Angeles 24, Calif., by W. J. Sheffler; Wesley B. Fleming, Arizona Game & Fish Commission, Phoenix, Ariz., Leo Pinkas, 632 S. Meyler St., San Pedro, Calif., and Mrs. H. K. Trousdale, 5932 La Salle Ave., Oakland 11, Calif., by F. H. Boynton; Wayne H. Bohl, 210 Agr. Eng. Bldg., Oregon State College, Corvallis, Ore., Herbert Hughes, 8622 W. Adams Blvd., Los Angeles 34, Calif., R. Wayne Nunes, 520 Oatman Ave., Sanger, Calif., Peter C. Petersen, Jr., 620 E. 30th St., Davenport, Iowa, Dorothy E. Snyder, The Peabody Museum, 161 Essex St., Salem, Mass., Frank E. Snyder, 4206 Newdale Dr., Los Angeles 37, Calif., and Don Spencer, Berkshire Game Farm, 271 Madison Ave., New York 16, N.Y., by Jack von Bloeker; Mrs. Harriet Price Craven, 2724 Fourth Ave., Sacramento 18, Calif., Hans Ragnar Edberg, Ekersgatan 38A, n.b., Orebro 4, Sweden, Mrs. Xenia Erickson, 5615 Harcross Dr., Los Angeles 43, Calif., J. Bernard

Gollop, Canadian Wildlife Service, University of Saskatchewan, Saskatoon, Sask., Canada, Charles F. Lambert, 444 W. Sycamore St., Willows, Calif., John L. Miller, 3310 W. Washington Blvd., Los Angeles 18, Calif., Reginald Cecil Miller, Standard Bank of So. Africa Ltd., 70 Stott Rd., Pietermeritzburg, Natal, So. Africa, J. G. Nicollaud, 48 Rue Descartes, Chinon, France, Brendan M. O'Malley, Anchor Buildings, Westport, County Mayo, Republic of Ireland, Miss Lotta Vesta Parsons, 1311½ Twenty-seventh St., Sacramento, Calif., Edwin R. Pickett, 3940 "N" St., Sacramento 19, Calif., Yvareg Shri Virbhadrasinghji Saheb of Bhavnagar, Nilambag Palace, Bhavnagar (Saurashtra, India), E. W. Sawyer, 425 N. June St., Los Angeles 4, Calif., Durward Bruce Swinehart, Jr., 2109 Juanita Lane, Sacramento 21, Calif., Trevenen Johns Taylor, 301 6th St., Davis, Calif., William Lay Thompson, Dept. of Zoology, University of California, Berkeley 4, Calif., and Thomas B. Thorson, Division of Natural Sciences, San Francisco State College, San Francisco 2, Calif., and Harold A. Zimerman, 2218 N. Linden St., Muncie, Indiana, all by C. V. Duff.

The Nominating Committee presented the names of Wade Fox, Jr., for president, Jean Delacour for first vice-president, John Davis for second vice-president, and Dorothy E. Groner for secretary; these persons were unanimously elected.

"My Five Years in Patagonia" was the subject of a talk given by J. R. Pemberton.—DOROTHY E. GRONER, *Secretary*.

FEBRUARY.—The monthly meeting of the Southern Division of the Cooper Ornithological Society was held February 24 at the University of Southern California. The following names were proposed for membership: Joel S. Newman, Jr., 10619 S. Paramount Blvd., Downey, Calif., by Wade Fox; John S. Stanton, Box 2495, Carmel, Calif., by Charles Anderson; J. William Hardy, 2015 McCord St., Murphysboro, Ill., and Mrs. Elizabeth D. Hodges, 6210 Paseo, Kansas City 4, Missouri, by J. C. von Bloeker; Mrs. Evelyn Barr, 362 N. Rexford Dr., Beverly Hills, Calif., Julian J. Baumel, Dept. of Biology, University of Florida, Gainesville, Fla., J. O. Clay, 169 Beach Drive, Victoria, B.C., Canada, Herbert Hamilton Frost, Ricks College, Rexburg, Idaho, Leon L. Gardner, M.D., 3129 Freeman St., San Diego 6, Calif., F. Nowell Jones, 14635 Whitfield Ave., Pacific Palisades, Calif., Edward Dunster Kremers, M.D., 2125 Mar Vista Ave., Atascadero, Calif., and Dr. A. C. Polak, Spoorstraat 15, Amersfoort, Netherlands, by C. V. Duff.

Dr. William R. Dawson discussed "Responses of Birds to Climatic Extremes."—DOROTHY E. GRONER, *Secretary*.

COOPER ORNITHOLOGICAL SOCIETY, INC.
STATEMENT OF CASH RECEIPTS AND DISBURSEMENTS
FOR THE YEAR ENDED DECEMBER 31, 1952

CASH IN BANK, DECEMBER 31, 1951			$ 6,502.38
ADD: CASH RECEIPTS			
General Publication Fund			
Membership dues, regular and sustaining	$5,879.39		
Subscriptions for the Condor	842.40		
Condor sales	735.62		
Phonograph record sales (35 records sold)	262.50		
Dividends and interest received on endowment funds invested (Note A)	2,265.83		
Contributions received for publication of the Condor	1,360.00		
Other cash receipts	38.00	$11,383.74	
Grayson Fund			
Contributions for engraving of Grayson plates		1,335.00	
Avifauna Fund			
Avifauna sales (net) (Note B)	$ 738.91		
Sales tax collected on Avifauna sales	9.43	748.34	
Endowment Fund			
Life memberships and installment payments received on life memberships	$ 650.00		
Contributions	299.89	949.89	14,416.97
			$20,919.35
DEDUCT: CASH DISBURSEMENTS			
General Publication Fund			
Publication costs of the Condor			
Printing	$7,113.97		
Engraving	933.20		
Purchases of back issues	97.09	$8,144.26	
Administrative expenses			
Northern division	$85.74		
Southern division	70.83		
Annual meeting	120.11		
Accounting	150.00		
Business manager	301.03		
Treasurer	298.80		
Editor	30.00	1,056.51	
Cost of one hundred phonograph records		475.73	
Other cash disbursements		32.24	
Total, General Publication Fund		$9,708.74	
Grayson Fund			
Engraving of Grayson plates		1,221.26	10,930.00
CASH IN BANK, DECEMBER 31, 1952			$9,989.35

CASH IN BANK ALLOCATED TO FUNDS AS FOLLOWS:

	December 31, 1951	December 31, 1952
General Publication Fund	$6,165.56	$7,840.56
Grayson Fund	99.92	213.66
Avifauna Fund	236.90	985.24
Endowment Fund (to be invested)		949.89
	$6,502.38	$9,989.35

NOTE A: On December 31, 1952, the business manager had in his custody endowment funds invested in corporate stocks which cost $25,122.29 and had a market value of $48,006.20, and a $100.00 U. S. Treasury Bond with a market value of $102.22. This endowment fund includes the contributions received in the names of Louis B. Bishop, Florence M. Bailey, Harry R. Painton, and Joseph Grinnell.

NOTE B: On December 31, 1952, the Society had a stock of Avifaunas for which the total of the quoted list prices was $27,444.00.

C. V. DUFF, *Business Manager*

Concerning Cooper Society Memberships and Subscriptions

Address C. V. DUFF, Business Manager, 1922 Tamarind Avenue, Hollywood 28, Calif.

Send dues, address changes, and advertisements to
Jack C. von Bloeker, Jr., Treasurer, 161 West 121st St., Los Angeles 61, California.

For Sale, Exchange, and Want Column—Each member of the Cooper Society is entitled to one short advertising notice in any issue of the Condor free. Notices of over 3 lines will be charged for at the rate of 25 cents per line. Send advertising copy to Jack C. von Bloeker, Jr.

WANTED—Two nests and sets of eggs of American Coot; one set perfect, one broken or incomplete will do; any reasonable price will be paid.—PAUL G. HOWES, *The Bruce Museum, Bruce Park, Greenwich, Conn.*

WANTED—Peters' Check-list of Birds of the World, vols. 2 and 5; please state condition and price.—ARTHUR ARONOFF, *59 W. 71 St., New York 23, N. Y.*

WANTED—Aves section of Zoological Record (or complete volume) for the following years: Vols. 2 to 5 (1865–1868), vols. 27 to 38 (1890–1901), and vol. 57 (1920).—RUDYERD BOULTON, *3234 Reservoir Rd., N.W., Washington 7, D.C.*

FOR SALE—Nomenclature of Colors for Naturalists and Compendium, etc., Ridgway, 1886, $28.00; Check List of African Mammals, Allen, $11.00; Naturalists' Guide to the Americas, $12.00.—H. H. T. JACKSON, *U. S. National Museum, Washington 25, D.C.*

WANTED—Birds of Korea, by O. L. Austin, Jr. (Mus. Comp. Zool., Harvard Univ.); also any publications in English or German on birds or other vertebrates of Japan, Northern China, or Korea. —ENSIGN ANDREW C. BROWNE, *USS T. E. Chandler (DD–717), % FPO, San Francisco, Calif.*

FOR SALE—Auk, 1899–1940, $75.00; Condor, 1911–1940, $50.00; Murrelet, complete through 1950, $35.00; Wilson Bulletin, 1935–1950, $15.00; all unbound, prices net; also bird paintings by S. Kobayshi and rare books on foreign birds—JAMES ROONEY, *1514 S. 12th Ave., Yakima, Wash.*

FOR SALE—Nearly complete set of "Der Vogelzug" (1930–1940), lacking only vol. 2; vol. 8, no. 2; and vol. 9, no. 4; first $30.00 check buys the file, delivery postpaid.—F. C. LINCOLN, *Fish and Wildlife Service, Washington 25, D.C.*

FOR SALE—Condor, vols. 14–31 (1912–1929), complete except July-August, 1913; $35.00, plus transportation.—GALE MONSON, *P. O. Box 1717, Parker, Ariz.*

BINOCULAR DATA—For details on how to use, choose and check a binocular for birding read our article, "Know Your Binoculars," published in Audubon Magazine, fully illustrated, reprint 10¢; no charge if you mention membership in the Cooper Ornithological Society. If your glass needs repair or coating, send it to us for a free estimate. If you need a new one, send for our free list of American, German and Japanese glasses—all guaranteed adjusted to U. S. Government specifications, and sent on 20 days' free trial. Liberal trade-in allowance. We also check glasses without charge and answer questions personally. If you have a binocular problem, let us help you solve it.—THE REICHERTS, *Mirakel Repair Co., Mount Vernon 15, N.Y.*

FOR SALE—The following volumes of the Condor: 1937, 1939 (no. 6 only), 1940, 1941 (no. 3 missing), 1942 (no. 3 missing), 1943, 1944, 1945, 1946, 1947, 1948. Will sell any one or all volumes. Make offer.—ERNEST S. BOOTH, *Walla Walla College, College Place, Washington.*

PREPARATION OF MANUSCRIPTS FOR THE CONDOR

Articles published in the Condor normally are written by members of the Cooper Ornithological Society. Practically all the Society's money goes into the journal; no editor or business manager receives any pay other than the satisfaction of doing a service worthily. The preparation of good copy by the author will contribute greatly to accuracy of published output, dispatch in handling, and economy of production.

To be acceptable for inclusion in the Condor, articles must not duplicate in any substantial way material that is published elsewhere. Any type of subject bearing on birds may be considered; but the geographic areas of primary concern are western North America, Central America, and the Pacific Basin. Manuscripts may be sent to the editors at the Museum of Vertebrate Zoology. Proofs with edited manuscripts will be sent to authors, at which time reprints may be ordered.

In the interests of accuracy and economy, observe the following: do not duplicate data in text, tables, or charts; check citations to original sources and verify text references; quoted statements must be exact replicas of the original; preferably use vernacular names applicable to the entire avian species (for a guide in this regard, see "The Distribution of the Birds of California," Pac. Coast Avif. No. 27, 1944:5-34); in general, avoid subspecific vernaculars; insert scientific names for species but not the subspecific name except in taxonomic papers or where the race concerned has been critically determined by the author or his collaborators; revise the manuscript repeatedly to remove superfluous words and phrases, immaterial detail, and repetitious statements.

Note Condor style and usage. "General Articles" and the "Field and Study" items are set up in different form. Provide a concise, meaningful title, and, where needed, subtitles within the text. Footnotes are not used. The address line may serve to indicate institutional connection, and to it should be added the date of transmittal of the manuscript. Terminal bibliographies are desirable where five or more titles are to be cited; otherwise, the references may be included in the text. For bibliographic style, note closely the practices employed in recent volumes of the journal. A factual summary is recommended for longer papers.

Rules for copy.—(1) Typewrite material, using one side of paper only; (2) double space *all* material and leave liberal margins; (3) use 8½ × 11 inch paper of standard weight (avoid onion skin); (4) carbon copies are not acceptable; (5) place tables on separate pages; (6) number pages in upper right hand corner.

Illustrations.—Photographs should be glossy prints of good contrast. Make line drawings with India ink; plan linework and lettering for at least ½ reduction; do not use typewritten labels on the face of the drawing. Provide typed legends on separate sheets.

Helpful references on writing: Manual of Style, University of Chicago Press, and Rules of the Editorial Committee, University of California Press. On scientific nomenclature: A.O.U. Check-list (with supplements 19 through 27) and Pacific Coast Avifauna No. 27; authors are not required to follow either of these works.

THE EDITORS OF THE CONDOR.